Notice

Hewlett-Packard to Agilent Technologies Transition

This documentation supports a product that previously shipped under the Hewlett-Packard company brand name. The brand name has now been changed to Agilent Technologies. The two products are functionally identical, only our name has changed. The document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.



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By internet, phone, or fax, get assistance with all your test and measurement needs.

Table 1-1 Contacting Agilent

Online assistance: `www.agilent.com/find/assist`

United States
(tel) 1 800 452 4844

Latin America
(tel) (305) 269 7500
(fax) (305) 269 7599

Canada
(tel) 1 877 894 4414
(fax) (905) 282-6495

Europe
(tel) (+31) 20 547 2323
(fax) (+31) 20 547 2390

New Zealand
(tel) 0 800 738 378
(fax) (+64) 4 495 8950

Japan
(tel) (+81) 426 56 7832
(fax) (+81) 426 56 7840

Australia
(tel) 1 800 629 485
(fax) (+61) 3 9210 5947

Asia Call Center Numbers

Country	Phone Number	Fax Number
Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

HP 8753A/B/C
NETWORK ANALYZER

HP 8702A/B
LIGHTWAVE COMPONENT ANALYZER
Service Manual

This manual applies directly to instruments with the following serial prefix numbers:

HP 8753A - 2950A and 2834U
HP 8753B - 2807A, 2828A, and 2849U
HP 8753C - 3029A and 3033U and 3310
HP 8702A - 2749A and 2828A
HP 8702B - 2918A and 3310

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MANUAL PART NO. 08753-90156

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EDITION 2

HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST, formerly NBS), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period corresponding to the individual warranty periods of its component products. Computer and computer peripherals are warranted for a period of 90 days. Instruments are warranted for a period of one year. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

Warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other areas, products must be returned to a service facility designated by HP.

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HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

BP24A.2

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).



Indicates hazardous voltages.



Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power, cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer make sure the common terminal is connected to the neutral (grounded side of the mains supply).

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from their power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

HP 8753A/B/C and HP 8702A/B Service Manual
CONTENTS

SERVICE AND EQUIPMENT OVERVIEW

Introduction 1
Organization of Service Manual 1
Table of Service Test Equipment 3

PREVENTIVE MAINTENANCE

Clean the Glass Filter 1
Clean the Fan Filter 2
Check the Front Panel Connectors 3
Check the Error Terms 3
Perform a Full 2-Port Calibration 3
Plot the Error Terms 4

ON-SITE VERIFICATION

Introduction 1
Verification Considerations 1
Comparison of On-Site Verification and Performance Tests 2

SYSTEM VERIFICATION

Introduction 3
System Verification Cycle and Kit Re-certification 3
Measurement Uncertainty 3
Equipment 4
Procedure 6
Initialization 6
Measurement Calibration 7
System Verification 9
In Case of Failure 12

SYSTEM TESTS

Frequency Range and Accuracy 15
Source Power Tests 17
Receiver Noise 300 kHz to 3 GHz 20
Receiver Noise Level Option 006 22
Source and Receiver Harmonics Option 002 24
System Test Record 27

LIGHTWAVE SYSTEM VERIFICATION

System Test (Thru/Receiver Calibration and Source Calibration) 31
Before Performing the Test 31
Procedure 31

PERFORMANCE TESTS

Introduction 1
Verification Considerations 2
Comparison of On-Site Verfication and Performance Tests 3

PERFORMANCE TESTS

Frequency Range and Accuracy Performance Test 5
Minimum R Level Performance Test 7
Receiver Noise Level Performance Test 9
Input Crosstalk Performance Test 11
R into B Crosstalk 12
B into A Crosstalk 12
A into B Crosstalk 12
Trace Noise Performance Test 14
Frequency Response Performance Test ... 16
Magnitude Ratio Accuracy 16
Phase Ratio Accuracy 17
Absolute Amplitude Accuracy Performance Test 18
Input Impedance Performance Test 21

AUTOMATED PERFORMANCE TESTS

Introduction 26
Setting Up the System 27
System Hardware Configuration 27
System Software Requirements 28

Software Backup 29
Disk Files 29
Making Working Copies 29
Copying to a Hard Disk or Double- Sided Flexible Disk 30
Copying Flexible Disks with Two Drives . 30
Copying Flexible Disks with One Drive ... 31
Getting Started 31
Loading the Performance Test Program . 31
System Configuration Menu 32
Performance Test Menu 33
Error Recovery 34
Output Power 36
Spectral Purity 41
Dynamic Accuracy 50

SUPPLEMENTAL PERFORMANCE TESTS FOR HP 8753B/C ONLY

HP 8753B/C Minimum R Level for External Source Performance Test 63
HP 8753B/C Option 002 Absolute Amplitude Accuracy Performance Test 65
HP 8753B/C Option 002 and 006 Absolute Amplitude Accuracy Performance Test 67
HP 8753B/C Option 002 Source and Receiver Harmonics Performance Test 69
Source Harmonics 70
Source and Receiver Harmonics 70
Receiver Harmonics 71
Analyzers with Option 006 71
HP 8753 & 8702 Option 006 Minimum R Level Performance Test 72
HP 8753B/C, HP 8702B Option 006 Input Crosstalk Performance Test 74
R-into-A Crosstalk 75
R-into-B Crosstalk 75
B-into-A Crosstalk 75
A-into-B Crosstalk 76
HP 8753B/C, HP 8702B Option 006 Frequency Response Performance Test 78
Magnitude Ratio Accuracy 79
Phase Ratio Accuracy 80
A/R Phase Ratio Accuracy 80
B/R Phase Ratio Accuracy 80
A/B Phase Ratio Accuracy 81
HP 8753B/C, HP 8702B Option 006 Compression Performance Test 82
HP 8753B/C, HP 8702B Option 006 Absolute Amplitude Accuracy Performance Test . 84
Supplemental Frequency Offset Mode Performance Test 86

ADJUSTMENTS AND CORRECTION CONSTANTS

Repair Sequence 1
Adjustment Error Messages 1
Order of Adjustments 2
Instrument Cover Removal 2
A9 CC (Correction Constant) Jumper Position .. 2
A9 CC Jumper Position Procedure 3
Display Intensity and Focus Correction Constants (HP 8753A/B and 8702A) 4
Display Image Size, Position and Trace Alignment Adjustments (HP 8753A/B and 8702A) 5
Vertical Position and Focus Adjustments (HP 8753C and 8702B) 7
Vertical Adjustment 7
Focus Adjustment 8
Display Degaussing (Demagnetizing) (HP 8753C and 8702B) 9
Display Intensity Adjustments (HP 8753C and 8702B) 10
Background Adjustment 10
Maximum Intensity Adjustment 11
Operating Default Intensity Adjustment 12
Serial Number Correction Constant 13
Option Numbers Correction Constant 14
Analog Bus Correction Constants 16
ADC Linearity Correction Constants 17
Fractional-N Frequency Range Adjustment . 18
Source Default Correction Constants 21
Source Pretune Correction Constants 22
Frequency Accuracy Adjustment 23
High/Low Band Transition Adjustment 25
Fractional-N Spur Avoidance and FM Sideband Adjustment 27
Source Spur Avoidance Tracking Adjustment 30
Sampler Diode Bias Adjustment (HP 8753A, 8753B*, and 8702A) 32

Sampler Magnitude and Phase Correction Constants 35
Power Sensor Calibration Factor Entry 36
Updating Sampler Correction Constants .. 37
Optional Check Procedure 39
RF Output Power Correction Constants 41
Power Sensor Calibration Factor Entry 42
Power Loss through Power Splitter Determination 43
Source Correction Routine 43
IF Amplifier Correction Constants 45
Cavity Oscillator Frequency Correction Constants 47
Spur Search Procedure with Filter 48
Spur Search Procedure without Filter 49
Cal Kit Default Correction Constants 52
EEPROM Backup Disk Procedure 53
How to Make an EEPROM Backup Disk and Store Correction Constant Data to It 53
How to Retrieve Correction Constant Data from the EEPROM Backup Disk 54

TROUBLESHOOTING

Repair Sequence 1
Introduction 1
Initial Observations 2
Operator's Check 2
Lightwave Troubleshooting 4
HP 8702A Stand-Alone Check 4
Troubleshooting HP-IB Systems 7
Troubleshooting Systems with Multiple Peripherals 8
Troubleshooting Systems with Controllers 8
Overall Block Diagram 9
Wiring List 10–13

ISOLATE FAULTY GROUP TROUBLESHOOTING

Introduction 1
Power Supply 2
Check the Rear Panel LEDs 2
Check the A8 Post-Regulator LEDs 2
Digital Control 2
Observe the Power Up Sequence 2
Verify Internal Tests Passed 3
Source 4
Phase Lock Error Messages 4
Check Source Output Power 5
No Oscilloscope or Power Meter? Try the ABUS 6
Receiver 7
Receiver Error Messages 8
Bad Data 8
Accessories 8
Accessories Error Messages 8
Isolate Faulty Group Worksheet 9

POWER SUPPLY TROUBLESHOOTING

Repair Sequence 1
Introduction 1
Power Supply Troubleshooting Summary 3
Start Here 4
Check the Green LED and Red LED on A15 4
Check the Green LEDs on A8 5
Measure the Post-Regulator Voltages 5
Find Out Why the Green LED on A15 Is Not On Steadily 6
Check the Line Voltage, Selector Switch, and Fuse 6
Find Out Why The Red LED On A15 Is On Or Flashing 7
Disconnect A15W1 7
Check A15 and Related Assemblies 8
Find Out Why The Green LEDs on A8 Are Not All On 12
Remove A8 From Motherboard Connector, Maintain A15W1 Cable Connection 12
Check the A8 Fuses and Voltages 12
Remove Assemblies 13
Install A9 and Disconnect Display Power Cable 13
Briefly Disable the Shutdown Circuitry ... 14
Inspect Motherboard 14
Error Messages 15
Fan Troubleshooting 17
Intermittent Problems 17
Power Supply Block Diagram 19

DIGITAL CONTROL TROUBLESHOOTING

Repair Sequence 1
Introduction 1
Part I. HP 8753A/B and 8702A 1
Start Here for the HP 8753A/B and 8702A 4
Check A9 CPU Operation 4
Check LED Pattern With Preset Key Held In 4
Check LED Pattern After Preset Key is Released 4
Check A18 Display Operation 4
Cycle Power and Look at the Display 4
Check Front Panel Control 6
Perform Preset and Watch the Front Panel LEDs 6
Front Panel Error Codes Test 6
A1/A2 Front Panel Troubleshooting 8
Press [PRESET] 8
All Front Panel LEDs Stay On 8
Random Front Panel LED Pattern 8
Run the Self Tests and Other Diagnostic Tests . 9
Check Preset 9
Internal Self Tests 9
Internal Test 12 11
External Tests 11
A18 Display Troubleshooting 11
Check Display Power Supplies 11
Check Display Test Pattern 12
Check Front Panel Control of Display Focus and Intensity 13
If the Fault is Intermittent 15
Repeat Test Function 15
Part II. HP 8753C and 8702B 16
Start Here For the HP 8753C and 8702B 18
Check A9 CPU Operation 18
Check LED Pattern After Cycling Power 18
Check LED Pattern With Preset Key Held In .. 18
Check LED Pattern After Preset Key is Released 18
Check A19 GSP and A18 Display Operation . 19
Cycle Power and Look at the Display 19
Perform Display Intensityand Focus Adjustments 19
A1/A2 Front Panel Troubleshooting 19
Check Front Panel LEDs After Preset 19
Identify Stuck Key 19
Inspect Cables 20
Test Using a Controller 20
Run the Internal Diagnostic Tests 20
A19 and A18 Display Troubleshooting 23
Measure Display Power Supply Voltages on A19 23
Measure Display Power Supply Voltages Entering A19 23
Run Display Test 58 24
Inspect Ribbon Cable and Repeat Display Test 58 24
Perform Walking One Pattern 25
Run Display Tests 59–64 25
If the Fault is Intermittent 26
Repeat Test Function 26
Part III. HP-IB Failures 27

SOURCE GROUP TROUBLESHOOTING

Repair Sequence 1
Introduction 1
Power 3
Phase Lock Error 4
Phase Lock Loop Error Message Check 4
A4 Sampler/Mixer Check 5
A3 Source and A11 Phase Lock Check 6
YO Coil Drive Check with Analog Bus 8
YO Coil Drive Check with Oscilloscope 9
A12 Reference Check 10
A12 Frequency Reference Signals Check 10
100 kHz Pulses 12
PLREF Waveforms 12
FN LO at A12 Check 14
4 MHz Reference Signal 15
2ND LO Waveforms 15
A12 Digital Control Signals Check 17
A13/A14 Fractional-N Check 18
Fractional-N Check with Analog Bus 18
A14 VCO Range Check with Oscilloscope 19
A14 VCO Exercise 21
A14 Divide-by-N Circuit Check 21
A14-to-A13 Digital Control Signals Check 22

A7 Pulse Generator Check 23
A7 Pulse Generator Check with Spectrum Analyzer 23
A7 Pulse Generator Check with Oscilloscope 25
A11 Phase Lock Check 27
Phase Lock Check with PLL DIAG 27
Phase Lock Check by Signal Examination 27
Source Group Troubleshooting Appendix .. 29
Troubleshooting Source Problems With the Analog Bus 29
Phase Lock Diagnostic Tools 29
Phase Lock Error Messages 29
Phase Lock Diagnostic Routines 30
HP 8753A Compatibility Considerations 31

RECEIVER TROUBLESHOOTING

Repair Sequence 1
Introduction 1
Receiver Failure Error Messages 3
Is Any Input Good? 4
Troubleshooting When All Inputs Look Bad ... 5
Run Internal Tests 18 and 17 5
Check 2nd LO 5
Check the 4 MHz REF Signal 5
Check A10 by Substitution or Signal Examination 5
Troubleshooting When One or More Inputs Look Good 7
Check the 4 kHz Signal 7
Check the Trace with the Sampler Correction Constants Off 8
Check 1st LO Signal at Sampler/Mixer 9
Check 2nd LO Signal at Sampler/Mixer 9

ACCESSORIES TROUBLESHOOTING

Possible Operation Problems 1
Full 2-Port Calibration Measurement Discrepencies 1
"Loose" Test Port Connectors 2
Odd Appearing Opens and Shorts 2
Mating 75 Ohm Connectors with 50 Ohm Connectors 2
Inspect the Accessories 2
Inspect and Gage Connectors 2
Switch Repeatability 3
Inspect Error Terms 3
Cable Test 5
Verify Shorts and Opens 5
Test Set Problems 6
Troubleshooting Power Problems in S-Parameter Test Sets 7
Troubleshooting Control Problems in S-Parameter Test Sets 8
Lightwave System Problems 10
Lightwave Source, Receiver, or Coupler problems 10
Other Problems 10

SERVICE KEY MENUS

Internal Diagnostics Summary 1
Tests Menu 3
Test Options Menu 4
Edit List Menu 4
Self Diagnose Softkey 5
Test Descriptions 5
Internal Tests 5
External Tests 7
Sys Ver Tests 7
Adjustment Tests 8
Display Tests 9
Test Patterns 9
Service Feature Menus 11
Service Modes Menu 12
Service Modes More Menu 13
Analog Bus Softkey 14
Description of the Analog Bus 14
The Main ADC 14
The Frequency Counter 14
Notes 14
Analog In Menu 15
Analog Bus Nodes 16
A3 Source 16
A10 Digital IF 20
A11 Phase Lock 21
A12 Reference 25
A14 Fractional-N (Digital) 27

Peek/Poke Menu 29
Firmware Revision Softkey 30
HP-IB Service Mnemonic Definitions 30
Invoking Tests Remotely 31
Symbol Conventions 31
Analog Bus Codes 31
ROM/RAM Tests 32

ERROR TERMS

Introduction 1
Measurement Calibration Procedure 2
Error Term Inspection 3
Hardcopy Procedure 4
Error Term Descriptions 4
Directivity (EDF and EDR) 5
Source Match (ESF and ESR) 6
Reflection Tracking (ERF and ERR) 7
Isolation (Crosstalk, EXF and EXR) 8
Load Match (ELF and ELR) 9
Transmission Tracking (ETF and ETR) 10

THEORY OF OPERATION

Introduction 1
System Theory 1
Test Sets 3
Analyzer Functional Groups 5
Power Supply Theory 5
A15 Preregulator 6
A8 Post-Regulator 7
Digital Control Theory 8
A1 Front Panel 9
A2 Front Panel Processor 10
A9 CPU 10
A18 Display 11
A19 GSP 11
A16 Rear Panel 11
Source Theory Overview 12
A14/A13 Fractional-N 12
A12 Reference 12
A7 Pulse Generator 12
A11 Phase Lock 12
A3 Source 12
A4 Sampler/Mixer 13
Source High Band Operation 13
Source Low Band Operation 15
Source Operation In Other Modes/Features (HP 8753B/C only) 17
Frequency Offset 17
Harmonic Analysis (Option 002) 17
External Source Mode 18
Tuned Receiver Mode 19
6 GHz Operation (Option 006 HP 8753B/C and 8702) 20
Receiver Theory 21
A4/A5/A6 Sampler/Mixer 21
A10 Digital IF 22

REPLACEABLE PARTS

Repair Sequence 1
Introduction 1
Rebuilt-Exchange Assemblies 1
Replaceable Parts List 2
Ordering Information 2

REPLACEMENT PROCEDURES

Repair Sequence 1
Introduction 1
A1/A2 Front Panel Replacement 1
A3 Source Replacement 5
A16 Rear Panel/A15 Preregulator Replacement 7
A18 Display Replacement 10

POST-REPAIR PROCEDURES

Introduction 1
Table of Related Service Procedures 1

INSTRUMENT HISTORY

The Purpose of Instrument History 1
How to Use this Section 1

INDEX

Service And Equipment Overview

INTRODUCTION

This *Service Manual* is a complete guide to servicing the HP 8753A/B/C network analyzer or the HP 8702A/B lightwave component analyzer alone or in a system. It is part of a manual set, which includes operating and programming information.

This manual contains information required to maintain, test, troubleshoot, and repair the analyzer. The rest of this section describes the organization of that information. This section also includes the *Table of Service Test Equipment*, which lists the equipment (and its critical specifications) required to monitor or adjust the instrument.

ORGANIZATION OF SERVICE MANUAL

Tabs are used to divide the major sections of this manual. The names of the tabs following this section, and the contents, are described below.

- *Preventive Maintenance* consists of routine tasks to be performed by the operator every six months or more often, to ensure that the instrument is maintained in good working condition.
- *On-Site Verification* consists of two parts. *System Verification* is a procedure designed to verify system-level error-corrected measurement performance. Known traceable standards are measured and compared with recorded data. This automated procedure is contained in firmware internal to the analyzer, and requires a disk drive.

  System Tests are efficient procedures designed to verify instrument performance not rigorously checked by *System Verification*, above.
- *Performance Tests* are step-by-step procedures that verify certain individual performance specifications of the analyzer.
- *Adjustments* provides instructions for adjustment and alignment of the instrument after repair or replacement of an assembly. Some of the adjustments are semi-automated procedures for altering correction constants (non-mechanical adjustments). The tab itself illustrates how to set the A9 CPU jumper to perform these procedures.

NOTE: The next eight, blue-tabbed sections are the core troubleshooting sections.

- *Troubleshooting and Block Diagram*. The troubleshooting strategy is to systematically verify portions of the analyzer, and thus narrow down the cause of a problem to the defective assembly. This section is the first of a series of troubleshooting procedures. It checks the operation of the analyzer independent of system peripherals, and suggests how to remedy system problems. The *Operator's Check* is located in this section. The tab also illustrates how to remove the instrument covers.

  The *Overall Block Diagram* and *Wiring List* conclude this section.

- *Isolate Faulty Group* is used after a problem has been shown to be in the analyzer. This initial *instrument* troubleshooting section can be used equally productively on location or over the phone to isolate the fault to one of the five functional groups in the analyzer.

- *Power Supply*
- *Digital Control*
- *Source*
- *Receiver*
- *Accessories*

  Each of the first four functional group sections above verifies its constituent assemblies until the faulty assembly is identified. *Accessories* verifies external RF cables and calibration kit devices.

- *Post-Repair Procedures* contains the *Table of Related Service Procedures*. It is a table of adjustments and verification procedures to be performed after repair or replacement of each assembly. This is the last of the blue-tabbed troubleshooting sections.

NOTE: The following sections are, for the most part, reference material.

- *Service Key Menus* documents the functions of the menus accessed from the ***[SERVICE]*** softkey. These menus let the operator test, verify, adjust, control and troubleshoot the analyzer. All internal tests and analog bus nodes are documented here. HP-IB service mnemonics are included.

- *Error Terms* can be powerful preventive maintenance and troubleshooting tools, besides being the basis for accuracy enhancement. This section documents the access and use of these internally-stored terms.

- *Theory of Operation* explains the overall operation of the instrument, the division into functional groups, and the operation of each functional group.

- *Replacement Procedures* provides procedures to disassemble portions of the instrument when certain assemblies are to be replaced. Cover removal is illustrated on this tab.

- *Replaceable Parts* provides part numbers and illustrations of the replaceable assemblies and miscellaneous chassis parts, together with ordering information.

- *Instrument History* contains backdating information required to make this manual compatible with earlier shipment configurations of the instrument.

TABLE OF SERVICE TEST EQUIPMENT

The first part of Table 1, *Service Test Equipment*, lists all of the equipment required to verify, adjust, and troubleshoot the analyzer and perform the operator's check. The table also notes the use and critical specifications of each item, and the recommended models.

Note that there are three different ways to test the performance of your analyzer. These are On-Site Verification, Performance Tests, and Operator's Check. The equipment required depends on which of these three you choose to use to test your system.

In addition to test equipment listed in Table 1, the following tools are also required:

- #1 and #2 Pozidriv screwdrivers.
- Flat-blade screwdrivers — small, medium, and large.
- 5/16 inch open-end wrench (for SMA nuts).
- 3/16 inch and 5/16 inch hex nut drivers.
- Non-conductive and non-ferrous adjustment tool.
- Needle-nose pliers.
- Tweezers.
- Anti-static work mat with wrist-strap.
- T10 and T15 TORX drivers.

Table 1. Service Test Equipment (1 of 3)

Instrument Required	Critical Specifications	Recommended Model	Use[1]
Series 200/300 Controller (mass storage as needed)	No substitute	HP 216, 226, 236, 220, 217, 310	P,A
BASIC 3.0 or higher Operating System	No substitute	HP 98613A	P,A
Printer	Raster graphics capability	HP 2225A, 9876A, 2671G, 82906A	P,V,A
Spectrum Analyzer	No substitute	HP 8566A/B	P,A
Frequency Counter	Frequency: 300 kHz-3 GHz 300 kHz-6 GHz for (Opt 006) Accuracy: 1 ppm	HP 5386A, 5342A, 5343A	P,A,V
Transmission/ Reflection Test Set	Frequency: 300 kHz-3 GHz Directivity: 30 dB	HP 85044A	P
Power Meter (HP-IB)	No substitute	HP 436A, 438A	P,A,T,V
Power Sensor	Frequency: 300 kHz-3 GHz	HP 8482A	P,A,T,V
Power Splitters: Two-way (2)	Frequency: 300 kHz-3 GHz Tracking between outputs: ±0.5 dB Output SWR: ± 1.1 dB	HP 11667A Opt 001	OC,V, P,A,T
Three-way	Frequency: 300 kHz-3 GHz Tracking between outputs: ±.25 dB Output SWR: ±1.1 dB	HP 11850C	P
100 dB Step Attenuator	No substitute	HP 8496A/G[2]	P
Attenuator/Switch Driver	No substitute	HP 11713A[2]	P
Type-N Calibration Kit	No substitute	HP 85032B[3,4]	P
Type-N 50 Ohm Termination (3)	Return loss, >30 dB	HP 908A	P,V
Fixed Attenuators: 3 dB 10 dB 20 dB (2) 30 dB	Return loss: >32 dB Type-N Type-N Type-N Type-N	 HP 8491A Opt. 003 HP 8491A Opt. 010 HP 8491A Opt. 020 HP 8491A Opt. 030	 P P,A,V P,A,V,T P,V
RF Cable Set	No substitute	HP 11851B	P,A, OC,T
RF Cables (2)	12″ Phase matched	HP 11500B	A
HP-IB Cables (5 max.)		HP 10833A/B/D	P,A,V

Table 1. Service Test Equipment (2 of 3)

Instrument Required	Critical Specifications	Recommended Model	Use[1]
Oscilloscope	Bandwidth: 100 MHz; Accuracy: 10%	any	A,T
DVM	Resolution: 10 mv	any	A
Coaxial Filter	Passband: 800 MHz; Rejection: 50 dB at 2.9 GHz	HP 360B	A
Tool Kit	No substitute	HP part number 08753-60023	A,T
Verification Kit	No substitute	HP 85029B	V
7 mm Calibration Kit	No substitute	HP 85031B	V
7 mm Test Port Return Cables	No substitute	HP 11857D	V,P
Disk Drive	CS80 protocol - SV only	HP 9122	V,P,A
Type-N Connector Gage Kit	Measurement uncertainty: $< \pm 0.0002$ in.	HP part number 85054-80011	M
Synthesized sweeper[5]	Harmonics: > -25 dBc Flatness: ± 1.1 dB	HP 8341A/B	P
Power sensor[6] RF Cable	Frequency: 3 GHz to 6 GHz $\geq$24 dB Return Loss (300 kHz to 2 GHz) $\geq$22 dB Return Loss (2 to 3 GHz)	HP 8481A HP part number 8120-4780 (P/O HP 11851B)	P V
RF Interface Kit[7]	No substitute	HP 11889A	V,T
Interconnect Cable Kit[7]	No substitute	HP 11886A, HP 11887A	V,T
Lightwave Source[7]	No substitute	HP 834xx-series	V
Lightwave Receiver[7]	No substitute	HP 834xx-series	V
BNC Cable		HP part number 8120-1840 or 8120-1839	P,A
Attenuator Drive Cable		HP part number 8120-2703	P
RF Cable		HP 85131C/D	A
S-parameter Test Set	Frequency Range 3 GHz to 6 GHz	HP 85047A	A
Photometer[8]		Tektronix J16	A
Photometer Probe[8]		Tektronix J6503	A

Table 1. Service Test Equipment (3 of 3)

Instrument Required	Critical Specifications	Recommended Model	Use[1]
Mixer[9]	RF, LO frequencies: 2 to 3 GHz IF frequency: 400 MHz Conversion loss: 7-8 dB	Mini-Circuits ZFM-15	P
Function Generator[9]	10 kHz square wave 100 mV pp	HP 8116A, 3312A	P
Adapter[9]	Type-N(m) to SMA(m)	HP part number 1250-1636	P
Adapters (2)[9]	Type-N(f) to SMA(m)	HP part number 1250-1562	P
Adapter[9]	Type-N(f) to BNC(m)	HP part number 1250-0077	P

1. **V** – On-site Verification
   OC – Operator's Check
   P – Performance Tests
   A – Adjustment
   T – Troubleshooting
   M – Preventive Maintenance
2. The performance test procedure uses the HP 8496G programmable attenuator with the HP 11713A attenuator driver, or the HP 8496A manual attenuator. To calibrate the HP 8496G, send it to Loveland Instrument Division, 815 14th Street SW, Loveland, CO 80537, ATTN: Standards Lab. Use a Customer Service Order form and request calibration data at 30 MHz, in 10 dB steps from 10 dB to 100 dB; provide the segment actuation sequence (40 dB uses segment 4, 50 dB uses 1 and 4, 60 dB uses 2 and 4, 70 dB uses 1, 2, and 4). The LID standards lab complies with MIL-STD 45662.
3. Minimum load specifications: >30 dB return loss, 300 kHz to 6 GHz.
4. Other calibration kits such as the HP 85054 can be used if the default calibration kit is modified.
5. Additional equipment required for HP 8753B/C.
6. Additional equipment required for HP 8753B/C option 006.
7. For use only with Lightwave Component Analyzer.
8. HP 8753C and 8702B only.
9. Only required for optional frequency offset mode performance test.

Preventive Maintenance

Preventive maintenance consists of four tasks. It should be performed at least every six months — more often if the instrument is used daily on a production line or in a harsh environment. Error terms, for example, are more meaningful when checked more often but, again, instrument usage should be the criterion. The tasks are:

- Clean the glass filter (and CRT as required).
- Clean the fan filter (where applicable).
- Check the front panel connectors.
- Check the error terms.

CLEAN THE GLASS FILTER (AND CRT AS REQUIRED)

1. A gasket between the CRT and glass filter limits dust infiltration between them. Thus cleaning the outer surface of the glass filter is usually sufficient. Use a soft cloth and, if necessary, a cleaning solution recommended for optical coated surfaces: HP part number 8500-2163 is one such solution.

   If, after cleaning the outer surface of the glass filter, the CRT appears dark or dirty or unfocused, clean the inner surface and the CRT.

2. Remove the softkeys cover (a plastic cover through which the front panel softkeys protrude): *carefully* insert a thin, flat screwdriver blade (or your fingernail) between the upper left corner of the softkeys cover and the glass filter (see Figure 1). Be extremely careful not to scratch or break the glass. Carefully pull the cover forward and off.

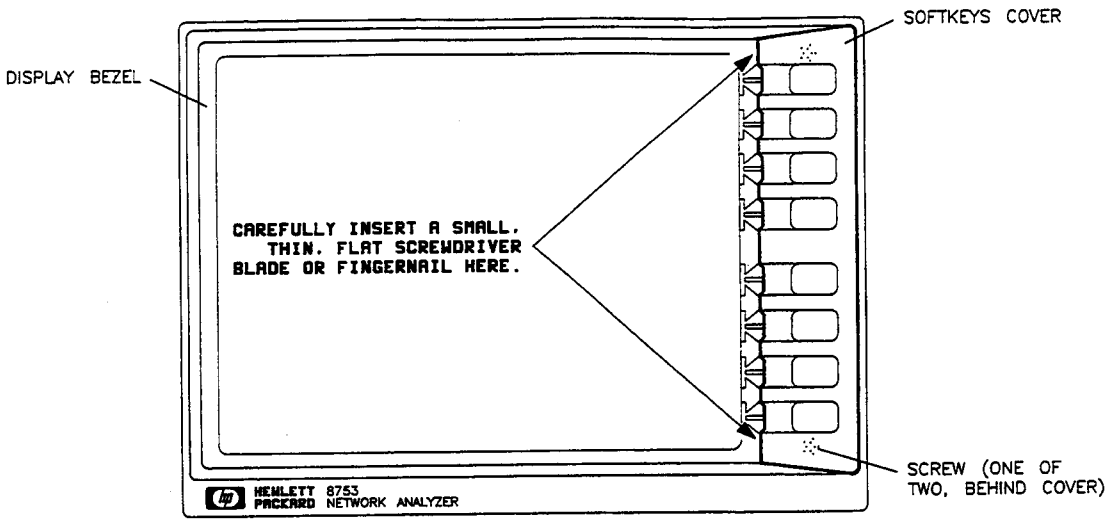

SOFTKEYS COVER
DISPLAY BEZEL
CAREFULLY INSERT A SMALL, THIN, FLAT SCREWDRIVER BLADE OR FINGERNAIL HERE.
SCREW (ONE OF TWO, BEHIND COVER)
HEWLETT PACKARD 8753 NETWORK ANALYZER

Figure 1. Removing the Glass Filter

3. Remove the two screws that are now uncovered.
4. Remove the display bezel assembly by pulling out the end that is now free and pivoting it around its left edge until it is released.
5. Clean the CRT surface and the inner glass filter surface gently, as in step 1.
6. Allow the surfaces to dry and then reassemble the instrument.

CLEAN THE FAN FILTER

NOTE: Newer versions of this product do not use a fan filter. If this is the case, ignore the following.

Clean the fan filter regularly. How regularly depends on the operating environment. It is a good idea to check it weekly and clean it as necessary.

Follow these steps:

1. Turn OFF the analyzer and disconnect the HP-IB cables from the rear panel.
2. Remove the plastic fan filter retainer — use either a flat blade screwdriver or your fingers to pry it off; it should "pop" off easily.
3. Clean the foam fan filter with a vacuum cleaner or shake it out thoroughly to remove the dust and dirt. Clean fan filters are nearly translucent.
4. Replace the fan filter and snap on the fan filter retainer.

CHECK THE FRONT PANEL CONNECTORS

Visually inspect the front panel connectors. The most important connectors are those to which the DUT is connected, typically the RF cable or test set connectors. But even the front panel connectors of the analyzer should be checked. All connectors should be clean and the center pins centered. Gage the analyzer connectors to confirm that the dimension is correct:

Front panel type-N (f) connector center pin protrusion: 0.201 to 0.207 inch

Also inspect and gage the connectors of the test set front panel, system RF cables, and calibration kit devices. Gage part numbers are listed in Table 1 of the *Service and Equipment Overview* section. Refer to the various manuals for center pin dimension specifications.

If the connectors are dirty or damaged, refer to the microwave connector care information in the *Operating Manual*. This information details connector care techniques including cleaning and gaging connectors, damage signs, making good connections, proper handling and storage.

CHECK THE ERROR TERMS

Error terms (E-terms or calibration coefficients) are an indication of the condition of the instrument, its test set, calibration kits, and cables. When tracked over a period of time, error terms can signal and identify system component and performance degradation. Error term comparisons are best made with data generated periodically by the same instrument, test setup and cal kit (the kit normally used with the analyzer). For this reason, generating error terms at the time of installation and at regular intervals thereafter is recommended. The following procedure is performed on an analyzer with an S-parameter test set.

A related recommendation is to establish a log book to store the error term plots and the results of the yearly verification.

Perform a Full 2-Port Calibration

To obtain hard copy error term plots, connect a printer or plotter to the analyzer via an HP-IB cable prior to turning on the instruments.

1. Turn on the instruments and press **[PRESET]** (HP 85047A: also press ***[FREQ RANGE 6 GHZ]***) **[LOCAL]** ***[SYSTEM CONTROLLER]*** to give control to the analyzer. Then press **[[CAL]** ***[CALIBRATE MENU] [FULL 2-PORT] [REFLECTION]*** to begin the calibration.

2. a. Connect an open to port 1 and press ***[(S11): OPEN]***.
   b. Connect a short to port 1 and press ***[(S11): SHORT]***.
   c. Connect a load to port 1 and press ***[(S11): LOAD]***.

3. Repeat step 2 for S22 at port 2. Press ***[REFLECTION DONE]*** for the analyzer to calculate the cal coefficients.

4. Press *[TRANSMISSION]*. Connect a single cable or cable pair, consistent with normal system use, between ports 1 and 2. Press *[FWD. TRANS. THRU] [FWD.MATCH THRU] [REV.TRANS THRU] [REV.MATCH THRU] [TRANS. DONE]*.

5. Connect loads to ports 1 and 2 or the cables (consistent with normal system use). Press *[ISOLATION] [FWD ISOL'N ISOL'N STD]*. After the beep, press *[REV ISOL'N ISOL'N STD] [ISOLATION DONE]* and then *[DONE 2-PORT CAL]*.

Plot the Error Terms

6. Press **[DISPLAY]** *[MORE] [TITLE] [ERASE TITLE]* and use the knob and softkeys to enter the serial numbers of the instrument and calibration kit, and the date. For example, INST=A12345/KIT=N67890/M-DD-YY. Press *[DONE]*.

7. Press **[SCALE REF]** *[REFERENCE POSITION]* **[7] [x1]** to position the display. Then press **[SYSTEM]** *[SERVICE MENU] [TESTS]* **[3] [2] [x1]** *[EXECUTE TEST]* **[COPY]** *[PLOT]* (or *[PRINT]*) to copy Cal Coef 1.

8. Repeat step 7, substituting the values of Table 1 to plot cal coefficients 2 through 12.

Table 1. Suggested Scale Ref and Connector Repeatability Values for Cal Coef Plots

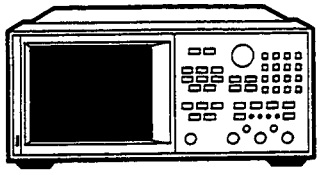
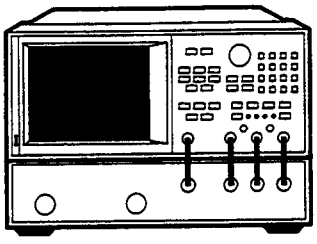
Cal Coef	Test	Scale Ref	Connector Repeatability
1 (E_{DF})	32	10	±5 dB
2 (E_{SF})	33	10	±2 dB
3 (E_{RF})	34	10	±1 dB
4 (E_{XF})	35	20	±5 dB
5 (E_{LF})	36	10	±2 dB
6 (E_{TF})	37	10	±0.5 dB
7 (E_{DR})	38	10	±5 dB
8 (E_{SR})	39	10	±2 dB
9 (E_{RR})	40	10	±1 dB
10 (E_{XR})	41	20	±5 dB
11 (E_{LR})	42	10	±2 dB
12 (E_{TR})	43	10	±0.5 dB

9. The plots generated should closely match previously generated plots. Variations due to connector repeatability factors are indicated in Table 1. Greater variations indicate system degradation due to changes in the cal kit devices, the test set connectors, or the analyzer itself.

   To compare the plots to typical plots of an HP 8753 with a HP 85046A or 85047A test set, refer to the *Error Terms* section. The *Accessories* section contains additional material.

10. Store the plots for future reference and for use as troubleshooting tools.

CHECKING INSTRUMENT OR SYSTEM PERFORMANCE

 **To test the INSTRUMENT by itself**	**ACCOMPLISH THIS**	 **To test the SYSTEM**
Do: Performance Tests Includes: • Basic HP 8753 and 8702 tests (all analyzers) • Supplemental HP 8753B/C tests (depends on model and option) **Refer to: Performance Tests Section**	⬅ Any Return-to-HP Standard Calibration On-Site Standard ➡ Calibration ⬅ MIL-STD 45662 ➡ Calibration	**Do: On-Site Verification** Includes: • System Verification (HP 8753) • System Tests (HP 8753) • Lightwave System Verification (HP 8702). **Refer to: On-Site Verification Section** *On-site services may not be available in all locations.
Do: Operation Verification Tests Includes: • Subset of 5 Performance tests **Refer to: Performance Tests Section**	⬅ Verify to 90% level of confidence that instrument meets specifications.	
Do: Operator's Check (HP 8753) Stand-Alone Check (HP 8702) **Refer to: Troubleshooting Section**	⬅ 80% confidence that analyzer is operating	

On-Site Verification

INTRODUCTION

There are two methods to verify that the analyzer is operating as specified: *On-Site Verification* and *Performance Tests*.

On-Site Verification consists of two types of procedures: *System Verification* and *System Tests.* This section describes those procedures.

To see how *On-Site Verification* and *Performance Tests* compare, see *Verification Considerations.*

VERIFICATION CONSIDERATIONS

The following table describes On-Site Verification and Performance Tests and compares their advantages.

Choose the method that meets your needs. It is not necessary to perform both.

Comparison of On-Site Verification and Performance Tests

On-Site Verification	Performance Tests
Description:	
On-Site Verification consists of *System Verification* and *System Tests*. *System Verification* measures a set of standards with the user's system and compares the results with traceable data. *System Tests* measures a few key performance specifications with additional test equipment.[1]	*Performance Tests* measure all warranted performance specifications with additional test equipment.[1]
What Specifications Are Tested:	
Total system-level uncertainty limits after accuracy enhancement[2] (and a few instrument specifications.)	Warranted instrument-level specifications of the analyzer.[3]
Where HP Performs The Test:	
On-site, at the user's location (where available).	At return-to-HP Service Centers.
What Equipment Is Tested:	
A complete 7 mm system, consisting of analyzer, test set, cables, calibration kit.[4]	The analyzer itself.
When Each Method Should Be Used:	
• Analyzer normally used in defined[4], integrated system. • System used with accuracy enhancement. • System usually makes ratioed measurements. • User prefers traditional microwave network analyzer method. • Subtle, system performance problems must be troubleshot.	• Analyzer normally used alone or in an undefined[4] system. • Instrument normally used without accuracy enhancement. • Analyzer makes non-ratioed or absolute amplitude measurements. • User prefers traditional lower-frequency, stand-alone method. • Gross, solid failure must be troubleshot.

1. See Table 1 in *Service and Equipment Overview* for details.
2. See *System Performance* section of *Operating Manual*.
3. See *Instrument Specifications* section of *Operating Manual*.
4. Defined on-site supportable systems are listed in *On-Site Verification*.

INTRODUCTION

Use system verification to verify system-level error-corrected uncertainity limits for the analyzer with a test set. See *Equipment*, in this section, for a list of system configurations for which this procedure is valid.

The verification procedure is automated and is contained in the firmware internal to the analyzer. The procedure involves first calibrating the analyzer, then measuring a set of verification devices (supplied in the HP 85029B 7 mm verification kit) at specific frequencies and comparing the measured data to the traceable data and uncertainty limits supplied with the kit on disk. The difference between the measured data and the supplied traceable data of the devices must fall within the uncertainty limits at *all* frequencies to pass the system verification. If this procedure is performed by a Hewlett-Packard Customer Engineer, and the system passes the verification at all frequencies, and passes all system tests, a Certificate of Traceability and a system verification sticker is issued.

SYSTEM VERIFICATION CYCLE AND KIT RE-CERTIFICATION

The recommended system verification cycle is every six months. It is also recommended that the verification kit be re-certified annually. For more information about kit re-certification, refer to the HP 85029B 7 mm Verification Kit manual.

MEASUREMENT UNCERTAINTY

Associated with any analyzer are measurement errors that add uncertainty to the measured results. This uncertainty defines how accurately a device under test (DUT) can be measured.

The accuracy enhancement procedure, also called measurement calibration, measures and removes the systematic (repeatable) errors. This is accomplished by measuring a set of calibration devices with known characteristics. However, residual systematic errors remain after accuracy enhancement primarily due to the limitations of how accurately the electrical characteristics of the calibration devices can be defined and determined. Also, there are other errors, known as *random* (non-repeatable) errors, that cannot be quantified and measured. The residual systematic errors along with the random errors continue to affect measurements after accuracy enhancement, adding a total uncertainty to the measurement results.

The measurement uncertainty is defined to be the sum of the residual systematic (repeatable) and random (non-repeatable) errors in the measurement system after accuracy enhancement. Systematic errors include directivity, source match, load match, reflection and transmission tracking, and isolation (crosstalk). Random errors include errors due to noise, drift, connector repeatability, and test cable stability. A complete description of the errors and how they affect measurements is provided in the *Reference* under *Accuracy Enhancement Fundamentals* in Chapter 5 — *Measurement Calibration*.

Measurement uncertainties of any analyzer system also depend upon the characteristics of the device under test. Expected measurement uncertainty of your analyzer system when measuring any device under test can be determined by using the equations provided in the *General Information and Specifications* section of the *Operating Manual*. The *Specifications* section also provides a system error model (flow graph) that shows the relationship of the systematic and random errors. This is useful for predicting overall measurement performance.

The measurement uncertainty limits for system verification are the sum of the worst-case uncertainties associated with measuring the verification devices on the factory analyzer system *plus* the worst-case uncertainties associated with measuring these same devices on the system being verified.

EQUIPMENT

The system verification procedure verifies the minimum analyzer system, which includes any of the following configurations:

	ANALYZER	TEST SET	CALIBRATION KIT	TEST PORT RETURN CABLES
•	HP 8753A	HP 85046A	HP 85031B	HP 11857D
•	HP 8753B/C	HP 85044A	HP 85031B	HP 11851B
•	HP 8753B/C	HP 85046A	HP 85031B	HP 11857D
•	HP 8753B/C Opt. 006	HP 85047A	HP 85031B	HP 11857D
•	HP 8702B	HP 85046A	HP 85031B	HP 11857D
•	HP 8702B Opt. 006	HP 85047A	HP 85031B	HP 11857D

The following equipment and accessories are required to verify the system:

- HP 85029B 7 mm Verification Kit
- HP 85029B Option 001 7 mm Verification Kit (for HP 8702B only)
- Disk drive (see Table 1 in the *Service and Equipment Overview* section for recommended HP models).
- Graphics printer (see Table 1 in the *Service and Equipment Overview* section for recommended HP models).
- HP-IB cables
- Adapter 7 mm to Type-N (f) (for HP 85044A only)

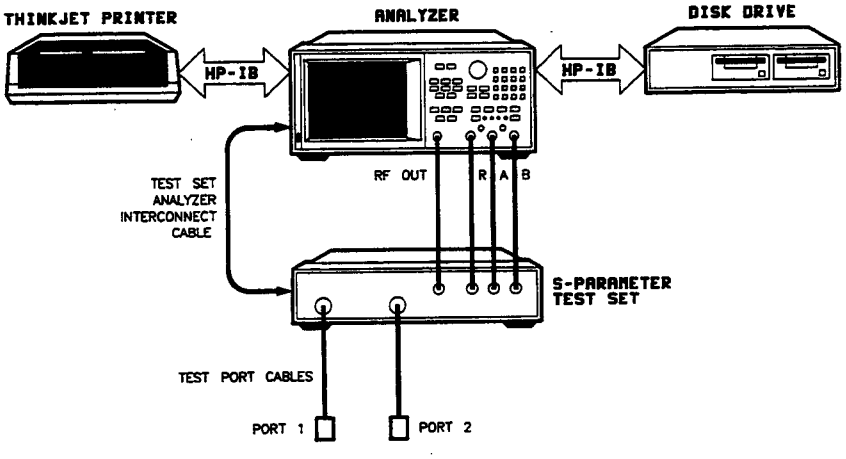


Figure 1. System Verification Setup (S-parameter Test Set)

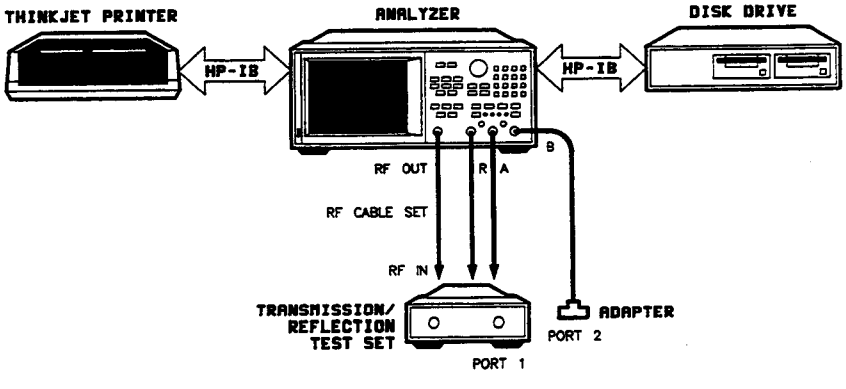


Figure 2. System Verification Setup (Transmission/Reflection Test Set)

PROCEDURE

1. Connect the system as shown in Figure 1 for an analyzer with an S-parameter test set. For an HP 8753B/C with an HP 85044A Transmission/Reflection Test Set, see Figure 2.

2. Insert your system verification disk (supplied in the HP 85029B verification kit) into disk drive 0 (left drive).

   The default unit number for the disk is 0. If necessary, press **[LOCAL]** ***[DISK UNIT NUMBER]*** and change to the appropriate setting. The default HP-IB address of the disk is 0. If necessary, press ***[SET ADDRESSES]*** and change the setting to reflect the actual address of the device.

3. Allow the system to warm up for 1 hour.

4. Review the connector care information supplied in the *Operating* manual for proper care and connection techniques of microwave connectors. Proper connections and clean, undamaged connectors are critical for accurate measurement results.

   NOTE: When cleaning and inspecting the open calibration device, you may notice a metal shim between the dielectric and the inner wall of the outer conductor. This is normal — do not try to remove it.

Initialization

5. Press **[PRESET]**, then **[LOCAL]** ***[SYSTEM CONTROLLER]***. This allows the analyzer to control the bus. No other controller should be connected to the bus.

6. If a printout of *all* verification data for *all* devices is required, press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [RECORD ON]***. Note that if this record function is turned ON now, it cannot be turned off during the verification procedure. Make sure the paper in the printer is set up so that printing starts at the top of the page. Verify that the printer address is set to 1.

   For the HP 8753C and 8702B, if a color printout of data is desired and the system printer is capable of a color output, press **[COPY]** ***[PRINT/PLOT SETUPS] [PRINT:COLOR]***.

   If a printout of data for only a particular verification device(s) is desired, go to the next step; the record function will be turned on later in the verification procedure.

7. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS] [SYS VER TESTS]***. The message "TEST 27 Sys Ver Init −ND−", will be displayed. The "−ND−" indicates the test status. A listing of the test status codes that may appear during this procedure is available in Table 1. If the record function is ON, "/REC" will also be displayed.

Table 1. Listing of Test Status Codes

Test Status Code	Meaning of Code
PASS	Pass
FAIL	Fail
(NA)	Not Available
−ND−	Not Done
−IP−	In Progress
DONE	Done

8. Press ***[EXECUTE TEST]***. This recalls the instrument state file from the disk and sets up the analyzer for a measurement calibration. When it's done initializing, "TEST 27 Sys Ver Init DONE" will be displayed.

Measurement Calibration

The following calibration procedures measure and remove the systematic errors present in the analyzer system. This involves measuring a set of calibration devices, supplied in the HP 85031B 7 mm calibration kit, with known electrical characteristics.The measurement calibration *must* be performed before continuing on to the system verification.

CAUTION

Do not press [PRESET] or recall a calibration from storage. The following calibration must be performed with the instrument state loaded during *Initialization.*

S-Parameter Test Set Measurement Calibration: Use this procedure for calibration of any analyzer system listed in *Equipment* containing an S-parameter test set (HP 85046A or 85047A). For an HP 8753B/C analyzer with an HP 85044A transmission/reflection test set, use the *Transmission/Reflection Test Set Calibration* procedure that follows this one.

9. HP 8702A/B only: Press **[CAL]** ***[DEVICE TYPE] [E/E]***.

   On the HP 8753, press **[CAL]**. On all analyzers, press ***[CALIBRATE MENU] [FULL 2-PORT] [ISOLATION]***. Connect one of the 50 ohm terminations (supplied in the HP 85031B calibration kit) to port 1, and the other termination to port 2. Press ***[FWD ISOL'N/ISOL'N STD]***.

10. When the measurement is complete (the instrument beeps and the softkey that was pressed is underlined), press ***[REV ISOL'N/ISOL'N STD]***.

11. When the measurement is complete, press ***[ISOLATION DONE] [REFLECTION] [S22: LOAD]***.

12. When the measurement is complete, disconnect the port 2 load. Connect the "short" end of the combination open/short (supplied in the HP 85031B calibration kit) to port 2. Press ***[S22: SHORT]***.

13. When the measurement is complete, disconnect the short. Connect the "open" end of the open/short to port 2. Press ***[S22: OPEN]***.

14. When the measurement is complete, disconnect the open. Press ***[S11:LOAD]***.

15. When the measurement is complete, disconnect the termination from port 1, then connect the "short" end of the open/short to port 1. Press ***[S11:SHORT]***.

16. When the measurement is complete, disconnect the short. Connect the "open" end of the open/short to port 1. Press ***[S11:OPEN]***.

17. When the measurement is complete, disconnect the open from port 1. Press ***[REFLECTION DONE] [TRANSMISSION]***. Connect port 1 to port 2 to form a thru configuration. Press ***[FWD.TRANS.THRU]***.

18. When the measurement is complete, press ***[FWD.MATCH.THRU]***.

19. When the measurement is complete, press ***[REV.TRANS.THRU]***.

20. When the measurement is complete, press ***[REV.MATCH.THRU]***.

21. When the measurement is complete, press ***[TRANS.DONE] [DONE 2-PORT CAL]***. Disconnect the thru.

22. The ***[SAVE]*** softkey menu is automatically displayed. Save the calibration in any register. Calibration is complete. Continue with *System Verification.*

Transmission/Reflection Test Set Calibration: Use this procedure for calibration of a system containing an HP 8753B/C analyzer and an HP 85044A transmission/reflection test set.

23. Press **[CAL]** ***[CALIBRATE MENU] [ONE-PATH 2-PORT] [ISOLATION]***. Connect one of the 50 ohm terminations (supplied in the HP 85031B calibration kit) to port 1, and the other termination to port 2. Press ***[FWD ISOL'N/ISOL'N STD]***.

24. When the measurement is complete (the instrument beeps and the softkey that was pressed is underlined), disconnect the termination from port 2. Press ***[ISOLATION DONE] [REFLECT'N] [S11:LOAD]***.

25. When the measurement is complete, disconnect the termination from port 1. Connect the "short" end of the combination open/short (supplied in the HP 85031B calibration kit) to port 1. Press ***[S11:SHORT]***.

26. When the measurement is complete, disconnect the short. Connect the "open" end of the open/short to port 1. Press ***[S11:OPEN]***.

27. When the measurement is complete, disconnect the open from port 1. Press ***[REFLECT'N DONE] [TRANSMISSION]***. Make a thru connection between port 1 and port 2. Press ***[FWD.TRANS.THRU]***.

28. When the measurement is complete, press ***[FWD.MATCH.THRU] [TRANS.DONE] [DONE 2-PORT CAL]***. Disconnect the thru.

29. The ***[SAVE]*** softkey menu is automatically displayed. Save the calibration in any register. Calibration is complete. Continue with *System Verification.*

System Verification

The following verification procedure is automated. The program is contained in the analyzer firmware so an external controller is not required. Three verification devices (contained in the HP 85029B 7 mm verification kit) are measured: a 20 dB attenuator, a 50 dB attenuator, and a mismatch attenuator. The mismatch attenuator is measured twice (once in each direction) for a total of 4 devices measured. For each verification device, the analyzer reads a file from the verification disk and sequentially measures the magnitude and phase for all four S-parameters. Not all of the S-parameters are required to verify system performance. Only the measurements used for verification are printed on the test record. For each device, Table 2 lists the device number, the device description, the test number where the device is used, and the S-parameters that are used for verification and printed on the test record.

Table 2. Verification Devices

Device Number	Device Description	Test Number	S-parameters
1	20 dB Attenuator	28	S11(M), S21(M), S21(P), S12(M), S12(P), S22(M)
2	50 dB Attenuator	29	S21(M), S21(P), S12(M), S12(P)
3	Mismatch Attenuator ("A" end on port 1)	30	S11(M), S11(P), S22(M), S22(P)
4	Mismatch Attenuator ("A" end on port 2)	31	S11(M), S11(P), S22(M), S22(P)

30. Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[28] [X1].**

31. In the active entry area on the CRT, the following will be displayed:

    "TEST 28 Ver Dev 1"

32. If the Record function was turned ON in step 7, or if a printout is not desired, go to the next step.

    If a printout of the data for this device is desired, press **[SYSTEM]** ***[SERVICE MENU]*** ***[TEST OPTIONS]*** ***[RECORD ON]*** **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS].*** Make sure the paper in the printer is set up so that printing starts at the top of the page.

33. Press ***[EXECUTE TEST].***

34. When prompted, connect the 20 dB attenuator verification device as shown in Figure 3 for an analyzer with an S-parameter test set. For an HP 8753B/C with an HP 85044A transmission/reflection test set, see Figure 4.

NOTE: When measuring the 20 and 50 dB attenuators, connect the device to port 1 with the device label facing the user, reading right.

35. Press ***[CONTINUE]***. The tests will begin.

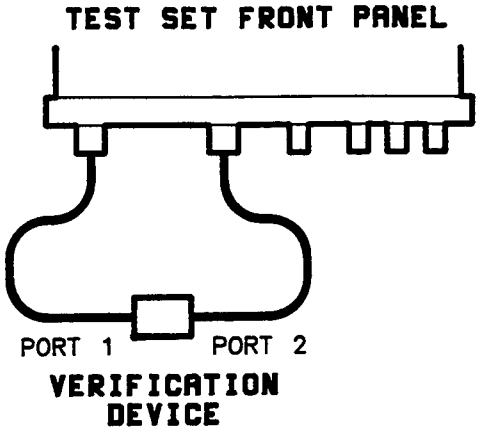


Figure 3. Setup For Verification Measurement (S-Parameter Test Set)

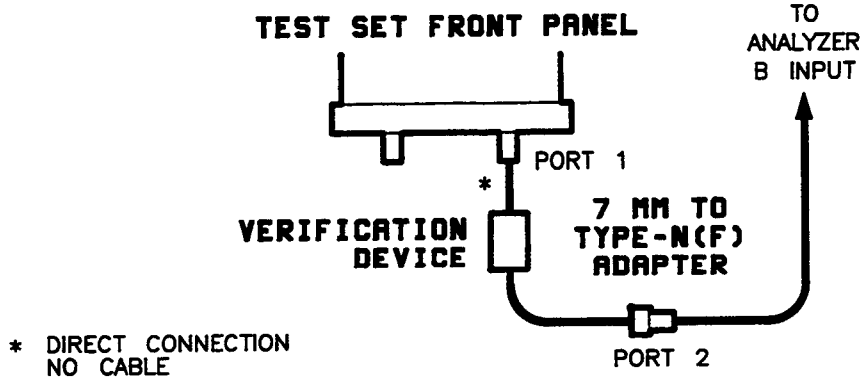


Figure 4. Setup For Verification Measurement (Transmission/Reflection Test Set)

36. If the record function is OFF (printout is not required), the program will pause after each S-parameter measurement and you will need to press **[CONTINUE]** after each measurement. (There are eight measurements for each device — magnitude and phase for four S-parameters.) For measurements using an HP 85044A, you will be prompted after the first sweep to turn the device around for a reverse sweep. Leave the device in this reversed orientation for the remainder of that test.

NOTE: Note that S-parameter measurements that are not useful for system verification will not display PASS/FAIL information. If a measurement fails, note which device and S-parameter failed and continue on with the remaining tests. Then go to the *In Case of Failure* procedure at the end of this section.

Also note that both the measured data and the factory data are displayed on the CRT.

If the record function is ON, the program will measure all S-parameters without pausing after each measurement. Note that only S-parameter measurements that are useful for system verification will be printed. While it is printing, a listing of the measured data will be displayed on the CRT.

37. When all measurements are complete, the TESTS softkey menu will appear. Disconnect the verification device.

38. Enter Test 29 (using step keys, entry keys, or RPG). Repeat steps 32 through 37 using the 50 dB attenuator verification device connected with the label facing the user, reading right.

39. Enter Test 30 (using step keys, entry keys, or RPG). Repeat steps 32 through 37 using the mismatch attenuator — with the "A" end connected to port 1. The HP 85044A user will be prompted to turn this device around also (as with the previous devices), and will complete this test with the device in this reversed orientation.

40. Enter Test 31 (using step keys, entry keys, or RPG). Repeat steps 32 through 37 using the mismatch attenuator. Connect the "A" end to port 2. The HP 85044A user will turn this device around after the first sweep also, ending the test with "A" connected to port 1.

41. The measurement printouts show both a plot of the measurement and a list of the measured frequencies with corresponding data. The plot includes both the measured data trace and the supplied factory data trace. The listing includes only the measured data. If there is a failure at any frequency, an asterisk will be next to the measured data and the out-of-specification measured data on the plot will be blanked out for the HP 8753A/B and 8702A or displayed in another color for the HP 8753C and 8702B.

IN CASE OF FAILURE

If the system fails the verification at any frequency, perform these checks to help determine the cause of failure. If the system fails to execute the initialization, ensure that it is in the SYSTEM CONTROLLER mode (press **[LOCAL]**), and repeat from *Initialization*.

1. Check all connections and connectors but do not disconnect the cables from the test port (doing so will invalidate the calibration). The connectors on the cables and the verification devices should be clean and properly gaged. Connections should be properly torqued. Refer to the microwave connector care information in the operating manual for complete information about connector care and making connections. After checking the connectors and connections, press **[PRESET]**, then recall the calibration (press **[RECALL]**, then the softkey corresponding to the register where you saved it). Repeat the test.

2. Check the three input power levels (R, A, and B) as follows:

   a. Press **[PRESET]**.

   b. Disconnect the verification device.

   c. Press **[MEAS]** ***[Refl: FWD S11 A/R] [INPUT PORTS] [A]***. For an HP 85044A test set, press **[MEAS]** ***[A]***. Typically, the beginning of the trace should be about −19 ±2 or 3 dB and the end should be about −24 ±2 or 3 dB. The trace will have some ripple, but there should be no large variations (power holes).

   d. For the system with an HP 85047A, also check the power levels over the 3 to 6 GHz range. Press **[MEAS]** ***[A] [FREQ RANGE] [6 GHZ]*** and repeat step c.

   e. Press ***[S PARAMETERS] [Refl: REV S22 B/R] [INPUT PORTS] [B]***. The trace should be similar to inputs A and R. For an HP 85044A, connect port 2 to port 1. Press **[MEAS]** ***[B]***. The beginning of the trace should be −13 ±2 or 3 dB and the end should be −18 ±2 or 3 dB.

   f. If any one of the port traces are not at the correct power levels, or if there are any power holes, suspect a problem in the test set or receiver. If all three inputs are bad, suspect the analyzer source.

3. Check the calibration:

   a. Recall the calibration. Press **[RECALL]**, then the softkey corresponding to the register where you saved it.

   b. Connect the short to port 1. Press **[MEAS]** ***[Refl: FWD S11 A/R]***. Set the scale to .05 dB/div. The trace should be 0.00 ±0.05 dB.

   c. Press **[FORMAT]** ***[PHASE]*** **[SCALE REF]** ***[PHASE OFFSET]*** **[1] [0] [X1]** ***[REFERENCE VALUE]*** **[1] [7] [0] [X1]**. Set the scale to 0.4 deg/div. The trace should be 0.00 ±0.4 deg.

d. Disconnect the short. Connect port 2 to port 1. Press **[FORMAT]** ***[LOG MAG]*** **[MEAS]** **[Trans: FWD S21 B/R]**. Set the scale to .05 dB/div. The trace should be 0.00 ± 0.05 dB.

If any of the traces are out of the limits given, repeat the calibration, then repeat the verification.

4. Print out the error terms. Refer to *Error Terms* for instructions and descriptions of the terms. Compare the E-term data with the uncorrected data listed in the tables of expected system performance under *System Performance* in the *General Information and Specifications* section of the *Operating Manual.*

5. Refer to *Troubleshooting and Block Diagram* for additional troubleshooting information.

Frequency Range and Accuracy

Specifications

Frequency Range: 300 kHz to 3 GHz
300 kHz to 6 GHz (analyzers with option 006)

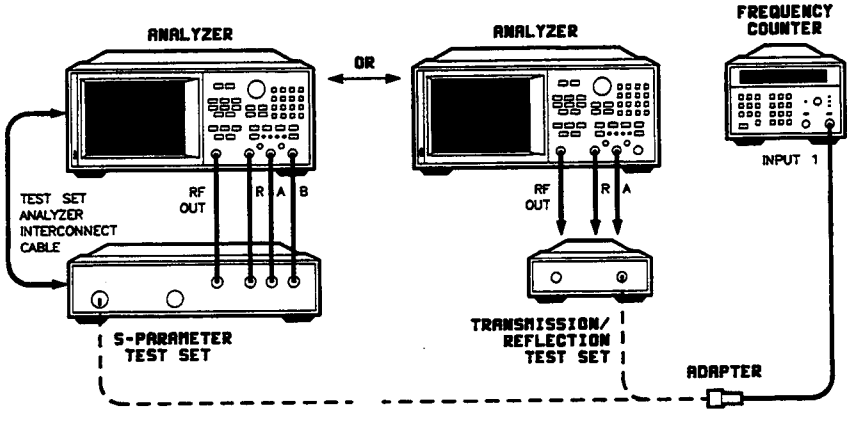


Figure 1. Frequency Range and Accuracy Test Setup

EQUIPMENT

Frequency Counter ..... HP 5342A
RF Cable ..... HP Part Number 8120-4780
Adapter ..... HP Part Number 85054-60001

DESCRIPTION AND PROCEDURE

This test checks the frequency accuracy of the analyzer over its entire frequency range. The frequency counter measures the frequency output at the test set test port. Refer to the *System Test Record*, in this section, for the frequencies to be measured, and to record results.

1. Connect the equipment as shown in Figure 1 using the setup containing your test set. An HP 8753B/C Option 006 must be used with the HP 85047A test set. Allow 30 minutes warm-up.
2. On the analyzer, press **[PRESET] [MENU]** ***[CW FREQ]*** to define the instrument state and allow entry of CW frequencies.
3. Press **[3] [0] [0] [k/m]** to select a CW frequency of 300 kHz. Record the frequency counter reading on the *System Test Record*.
4. Repeat step 3 for each instrument frequency listed on the *System Test Record*. To test the frequencies above 3 GHz (HP 85047A only), press **[SYSTEM]** ***[FREQ RANGE 6 GHZ]*** **[MENU]** ***[CW FREQ]*** and continue to select CW frequencies.

IN CASE OF FAILURE

If any frequency measured is close to the specification (either passing or failing), check the time base accuracy of the frequency counter.

If the analyzer fails by a significant margin at all frequencies (especially if the deviation increases with frequency), adjust the analyzer master time base. Refer to *Adjustments* for the *Frequency Accuracy Adjustment*. If the problem persists, refer to *Source* troubleshooting.

Source Power Tests

Specifications

Power Level Flatness: ≤2 dB
Power Level Accuracy: 10 dBm ±0.5 dB (50 MHz)

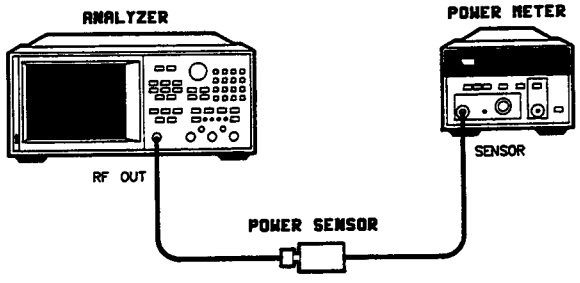


Figure 2. Flatness and Power Level Accuracy Test Setup

EQUIPMENT

Power Meter	HP 436A or 438A
Power Sensor	HP 8482A
Power Splitter	HP 11667A Option 001
Attenuator 20 dB	HP 8491A Option 020

DESCRIPTION AND PROCEDURE

The source is tested for power level flatness and power level accuracy. Flatness is tested at +15 dBm and −5 dBm at 9 CW frequencies. Power level accuracy is measured at +10 dBm at a CW frequency of 50 MHz. The analyzer source tune mode is used for both tests which allows power leveling and frequency control of the source without phaselocking. A power splitter is not used for these tests so that its frequency response will not impact the flatness test.

Since flatness is only measured at 9 points, an additional check is performed for power holes. The test for power holes sets a 0 dB reference at 1 GHz. Then, using a very slow sweep, 201 points are measured across the entire frequency range for relative power deviation. A variation of 2 dB peak-to-peak is allowed.

Refer to the *System Test Record* to record results and for specifications.

Zero and calibrate the power meter for each of the following tests. Set the power meter to measure dBm. Set the power meter cal factor whenever necessary to compensate for variations in power sensor frequency response.

Power Level Flatness (+15 dBm)

1. Connect the equipment as shown in Figure 2. Allow 30 minutes warm-up.
2. On the analyzer, press **[PRESET] [MENU]** ***[POWER]*** **[1] [5] [X1]** to set the power level to +15 dBm. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SRC TUNE ON]*** to access source tune mode.
3. Press **[3] [0] [0] [k/m]** to set the CW frequency to the first frequency listed on the *System Test Record*. Record the power meter reading on the *System Test Record*.
4. Repeat step 3 for each CW frequency listed.
5. On the *System Test Record*, record the difference between the maximum and minimum power levels measured in steps 3 and 4.

Power Level Flatness (−5 dBm)

6. On the analyzer, press **[PRESET] [MENU]** ***[POWER]*** **[-] [5] [X1]** to set the power level to −5 dBm. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SRC TUNE ON]*** to access source tune mode.
7. Press **[3] [0] [0] [k/m]** to set the CW frequency to the first frequency listed on the *System Test Record*. Record the power meter reading on the *System Test Record*.
8. Repeat step 7 for each CW frequency listed.
9. On the *System Test Record*, record the difference between the maximum and minimum power levels measured in steps 7 and 8.

Power Level Accuracy

10. Set the 50 MHz power meter cal factor for the power meter.
11. On the analyzer, press **[PRESET] [MENU]** ***[POWER]*** **[1] [0] [X1]** to set the power level to +10 dBm. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SRC TUNE ON]*** **[5] [0] [M/μ]** to access source tune mode at a CW frequency of 50 MHz. Record the power meter reading on the *System Test Record*.

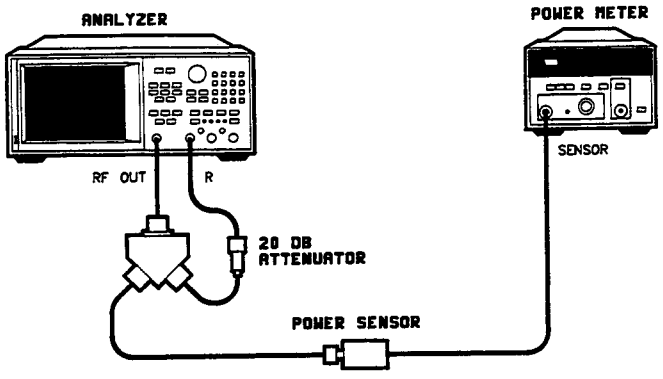


Figure 3. Power Hole Test Setup

Power Holes

12. Connect the equipment as shown in Figure 3.
13. On the analyzer, press **[PRESET] [MEAS]** ***[R]*** **[MENU]** ***[POWER]*** **[-] [5] [X1]** to measure the R input at a power level of −5 dBm.
14. Press **[MENU]** ***[CW FREQ]*** to set the analyzer to its default CW frequency of 1 GHz. To set this point as the 0 dB reference on the power meter, press **[dB/REF]** on the HP 436A (press **[REL]** on the HP 438A).
15. On the analyzer, press **[MENU]** ***[SWEEP TIME MANUAL]*** **[3] [0] [0] [X1]** ***[SWEEP TYPE MENU]*** ***[LOG FREQ]*** to set the sweep time to 300 seconds (5 minutes) in a logarithmic format. Read the power meter levels for the next 1 sweep (5 minutes) and verify that all points are within 2 dB. Record pass or fail on the *System Test Record*.
16. On the analyzer, press **[MENU]** ***[POWER]*** **[2] [0] [X1]** to set the analyzer power level to +20 dBm. Repeat steps 14 and 15 and record pass or fail on the *System Test Record*.

Receiver Noise 300 kHz to 3 GHz

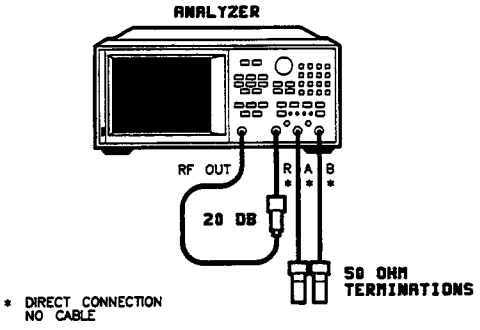


Figure 4. Receiver Noise Level Test Setup

EQUIPMENT

20 dB attenuator	HP 8491A option 020
50Ωtermination (2)	HP 908A
RF cable	HP part number 8120-4780

DESCRIPTION AND PROCEDURE

This test determines the receiver noise level (noise floor), the ultimate limit of receiver sensitivity. Linear format is used to avoid skewing the data with the marker statistics function. Input R is not tested as it is used for phase locking the source. See the *System Test Record* (at the end of the section) for specifications. Allow 30 minutes warm-up.

1. Connect the equipment as shown in Figure 4 and press **[PRESET] [MENU]** ***[POWER]*** **[-] [1] [0] [x1] [MKR FCTN]** ***[STATS ON]*** to set up the instrument. When ***[STATS ON]*** is pressed, *mean*, *s.dev*, and *p-p* values will appear.

2. Press **[MEAS] [A] [FORMAT]** ***[LIN MAG]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input A 3 kHz IF BW trace *mean* value on the *System Test Record.* The *System Test Record* shows the specification in both dBm and μU. (Pressing **[SCALE REF]** ***[AUTO SCALE]*** will bring the trace into view.) U (units) are related to volts and are defined by the following equation: power (dBm) $=20\ \mathrm{Log}_{10}$(Linear Magnitude measured value)

3. Press **[MEAS]** ***[B]*** **[FORMAT]** ***[LIN MAG]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input B 3 kHz IF BW trace *mean* value on the *System Test Record.*

4. Press **[AVG]** ***[IF BW]*** **[1] [0] [x1]** to select an IF bandwidth of 10 Hz. Disregard the CRT message "SWEEP TIME INCREASED". Press **[MENU]** ***[TRIGGER MENU] [SINGLE].*** Wait for one sweep and note the input B 10 Hz IF BW trace mean value on the *Record*.

5. Press **[MEAS] [A] [MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input A 10 Hz IF BW trace mean value on the *Record*.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: A10 digital IF assembly, if both inputs fail.

Related adjustment: ADC linearity correction constants.

To troubleshoot: see *Receiver*.

Receiver Noise Level Option 006

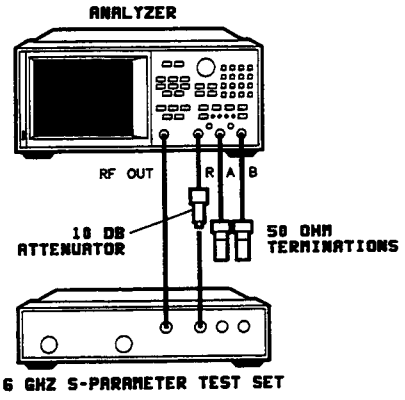


Figure 5. 6 GHz Noise Level Test Setup

EQUIPMENT

Attenuator 10 dB ..... HP 8491A Option 010
Termination 50 Ohm ..... HP 908A
RF Cable ..... HP Part Number 8120-4780

DESCRIPTION AND PROCEDURE

Receiver noise level from 3 GHz to 6 GHz is determined by connecting 50 ohm terminations to the analyzer A and B inputs and measuring the mean trace value in linear magnitude format. This noise level ultimately limits the sensitivity of the receiver. Linear format is used to avoid skewing the data with the marker statistics function. See the *System Test Record* for specifications. Allow 30 minutes warm-up.

1. Connect the equipment as shown in Figure 5. Press **[PRESET]** ***[FREQ RANGE 6 GHZ]*** to set the frequency range to 3 MHz to 6 GHz with a default 3 kHz bandwidth. Press **[MEAS]** ***[INPUT PORTS]*** ***[A]*** **[FORMAT]** ***[LIN MAG]*** **[SCALE REF]** ***[AUTO SCALE]*** to format the A input.

2. Press **[MKR FCTN]** ***[STATS ON]*** to display marker statistics.

3. Press **[MENU]** ***[TRIGGER MENU]*** ***[SINGLE]*** to enable a single sweep. Record the input A 3 kHz IF bandwidth trace mean value (displayed as a marker statistic) on the *System Test Record*. The specification is shown on the *System Test Record* in μU and dBm. U (units) are related to volts and are defined by the following equation: power (dBm) = 20 Log_{10} (Linear Magnitude measured value).

4. Press **[MEAS]** ***[INPUT PORTS]*** ***[B]*** **[FORMAT]** ***[LIN MAG]***.
5. Repeat step 3 for input B with a 3 kHz IF bandwidth.
6. Press **[AVG]** ***[IF BW]*** **[1]** **[0]** **[X1]** to select an IF bandwidth of 10 Hz. Disregard the CRT message SWEEP TIME INCREASED.
7. Repeat step 3 for input B with a 10 Hz IF bandwidth.
8. Press **[MEAS]** ***[INPUT PORTS]*** ***[A]*** to select input A magnitude.
9. Repeat step 3 for input A with a 10 Hz IF bandwidth.

IN CASE OF FAILURE

If both inputs fail, suspect the A10 digital IF assembly.

Related adjustment: ADC linearity correction constants.

To troubleshoot, see *Receiver*.

Source and Receiver Harmonics Option 002

Specifications

Source:	2nd Harmonic −25 dBc
	3rd Harmonic −25 dBc
Source and Receiver:	2nd Harmonic −15 dBc
	3rd Harmonic −30 dBc
Receiver:	2nd Harmonic −15 dBc
	3rd Harmonic −30 dBc

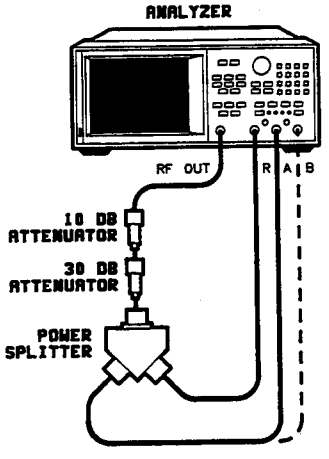


Figure 6. Source Harmonics Test Setup

EQUIPMENT

Power Splitter	HP 11667A Option 001
Attenuator 30 dB	HP 8491A Option 030
Attenuator 10 dB	HP 8491A Option 010

DESCRIPTION AND PROCEDURE

The harmonics tests use the marker search function to measure the worst case 2nd and 3rd harmonics of the source, source and receiver combination, and receiver. Compare the measured results to the specifications listed in the *System Test Record*.

Source Harmonics

1. Connect equipment as shown in Figure 6. Allow 30 minutes warm-up. Set the analyzer operating parameters.

   Press **[PRESET] [MENU]** ***[POWER]*** **[2] [0] [X1]** to set the power level to +20 dBm.

   Press **[START] [1] [6] [M/μ]**. On the analyzer, press **[STOP] [1] [.] [5] [G/n]** to set the frequency range.

   Set the IF bandwidth. Press **[AVG]** ***[IF BW]*** **[1] [0] [X1]**.

2. Press **[MEAS]** ***[A]***. After one sweep press **[DISPLAY]** ***[DATA→MEMORY] [DATA/MEM]***. This will normalize the trace and record the fundamental.

3. Press **[SYSTEM]** ***[HARMONIC MEAS] [SECOND]***. After one sweep, press **[MKR FCTN]** ***[MKR SEARCH] [MAX]***. Record the marker 1 power level on the *System Test Record* as the worst case source 2nd harmonic.

4. Change the stop frequency to measure the 3rd harmonic. On the analyzer, press **[STOP] [1] [G/n]**.

5. Find the worst case 3rd harmonic. Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]*** **[DISPLAY]**. After one sweep, press ***[DATA→MEMORY]*** to normalize the trace and record the fundamental. Press **[SYSTEM]** ***[HARMONIC MEAS] [THIRD]***. After one sweep, press **[MKR FCN]** ***[MKR SEARCH] [MAX]***. Record the marker value on the *System Test Record*.

Source and Receiver Harmonics

6. Remove the 10 dB attenuator from the test setup shown in Figure 6 to measure the combination of source and receiver harmonics.

   Press **[MENU]** ***[POWER]*** **[6] [X1] [SYSTEM]** ***[HARMONIC MEAS] [OFF]***. On the analyzer, press **[STOP] [1] [.] [5] [G/n]**.

7. Repeat steps 2 and 3 to measure source and receiver 2nd harmonic for input A.

8. Repeat steps 4 and 5 to measure source and receiver 3rd harmonic for input A.

9. Move the A input cable to input B.

   Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]*** to turn off harmonic mode.

   Set the stop frequency. On the analyzer, press **[STOP] [1] [.] [5] [G/n]**.

10. Repeat steps 2 and 3, using input B, to measure source and receiver 2nd harmonic for input B.

11. Repeat steps 4 and 5, using input B, to measure source and receiver 3rd harmonic for input B.

Receiver Harmonics

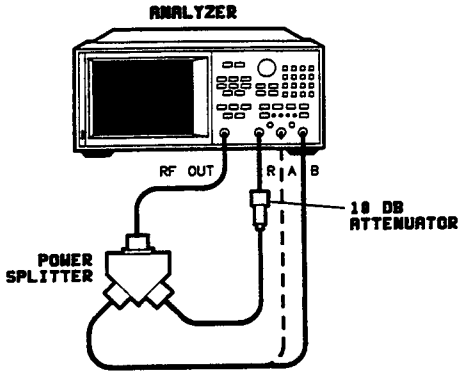


Figure 7. Receiver Harmonics Test Setup

12. Connect the equipment as shown in Figure 7, with the cable connection to input B.

    Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]***. On the analyzer, press **[STOP] [1] [.] [5] [G/n]**.

13. Repeat steps 2 and 3, using input B, to measure receiver 2nd harmonic for input B.

14. Repeat steps 4 and 5, using input B, to measure receiver 3rd harmonic for input B.

15. Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]***, then repeat steps 2 and 3, using input A, to measure receiver 2nd harmonic for input A.

16. Repeat steps 4 and 5, using input A, to measure receiver 3nd harmonic for input A.

Analyzers with Option 006

To test the high frequency range of all analyzers with option 006, repeat steps 1 through 16 with the following changes:

- Set the analyzer stop frequency to 3 GHz, instead of 1.5 GHz, to measure 2nd harmonics.
- Set the analyzer stop frequency to 2 GHz, instead of 1 GHz, to measure 3rd harmonics.
- Record all results on the System Test Record under Source and Receiver Harmonics for *Instruments with Option 006*.

IN CASE OF FAILURE

If source harmonics fail, replace the A3 source assembly.

If the A receiver fails, replace the A5 sampler.

If the B receiver fails, replace the A6 sampler.

Model Number: _____ Operator: _____

Serial number: _____ Temperature: _____

Date and time: _____ Humidity: _____

NOTE: Attach *System Verification* plots behind.

FREQUENCY RANGE AND ACCURACY

Instrument Frequency	Specification (±10 ppm) Lower Limit		Upper Limit	Measured Value	Step
300 kHz	299.997	to	300.003 kHz	_____	3
10 MHz	9.999 900	to	10.000 100 MHz	_____	4
100 MHz	99.999 000	to	100.001 000 MHz	_____	4
1 GHz	0.999 990	to	1.000 010 GHz	_____	4
3 GHz	2.999 970	to	3.000 030 GHz	_____	4
HP 8753B/C Option 006/HP 85047A ONLY					
4 GHz	3.999 600	to	4.00 40 GHz	_____	4
5 GHz	4.999 500	to	5.000 500 GHz	_____	4
6 GHz	5.999 400	to	6.000 600 GHz	_____	4

SOURCE POWER TESTS

Power Level Flatness

Instrument Frequency	Instrument Power Level	Measured Value	Step	Instrument Power Level	Measured Value	Step
300 kHz	+15 dBm	_____	3	−5 dBm	_____	7
20 MHz	+15 dBm	_____	4	−5 dBm	_____	8
50 MHz	+15 dBm	_____	4	−5 dBm	_____	8
100 MHz	+15 dBm	_____	4	−5 dBm	_____	8
200 MHz	+15 dBm	_____	4	−5 dBm	_____	8
500 MHz	+15 dBm	_____	4	−5 dBm	_____	8
1 GHz	+15 dBm	_____	4	−5 dBm	_____	8
2 GHz	+15 dBm	_____	4	−5 dBm	_____	8
3 GHz	+15 dBm	_____	4	−5 dBm	_____	8

SOURCE POWER TESTS (Cont'd)			
Delta Max-Min	**Specification**	**Calculated Value**	**Step**
at +15 dBm	≤2 dB	_____	5
at −5 dBm	≤2 dB	_____	9
Power Level Accuracy			
Frequency	**Specification**	**Measured Value**	**Step**
50 MHz	10 dBm ±0.5 dB	_____	11
Power Holes			
Measurement	**Specification**	**Pass/Fail**	**Step**
−5 dBm	≤2 dB	_____	15
+20 dBm	≤2 dB	_____	16
RECEIVER NOISE LEVEL			
Measurement	**Specification**	**Measured Value**	**Step**
300 kHz to 3 GHz Test			
Input A 3 kHz IF	≤−90 dBm/31.6 µU	_____	2
Input B 3 kHz IF	≤−90 dBm/31.6 µU	_____	3
Input B 10 Hz IF	≤−100 dBm/10 µU	_____	4
Input A 10 Hz IF	≤−100 dBm/10 µU	_____	5
RECEIVER NOISE LEVEL OPTION 006			
Measurement	**Specification**	**Measured Value**	**Step**
3 GHz to 6 GHz Test			
Input A 3 kHz IF	≤−85 dBm/56.2 µU	_____	3
Input B 3 kHz IF	≤−85 dBm/56.2 µU	_____	5
Input B 10 Hz IF	≤−95 dBm/17.8 µU	_____	7
Input A 10 Hz IF	≤−95 dBm/17.8 µU	_____	9

SOURCE AND RECEIVER HARMONICS OPTION 002			
Measurement	**Specification**	**Measured Value**	**Step**
Source			
2nd Harmonic	<-25 dBc	_____	3
3rd Harmonic	<-25 dBc	_____	5
Source/Receiver			
2nd Harmonic (A)	<-15 dBc	_____	7
3rd Harmonic (A)	<-30 dBc	_____	8
2nd Harmonic (B)	<-15 dBc	_____	10
3rd Harmonic (B)	<-30 dBc	_____	11
Receiver			
2nd Harmonic (B)	<-15 dBc	_____	13
3rd Harmonic (B)	<-30 dBc	_____	14
2nd Harmonic (A)	<-15 dBc	_____	15
3rd Harmonic (A)	<-30 dBc	_____	16

Instruments with Option 006

Source Harmonics

Instrument Stop Frequency	Harmonic	Specification	Measured Value	Step
3.0 GHz	2nd	−25 dBc	_____	3
2.0 GHz	3rd	−25 dBc	_____	5

Source and Receiver Harmonics

Instrument Stop Frequency	Harmonic	Specification	Measured Value	Step
3.0 GHz	A: 2nd	−15 dBc	_____	7
2.0 GHz	A: 3rd	−30 dBc	_____	8
3.0 GHz	B: 2nd	−15 dBc	_____	10
2.0 GHz	B: 3rd	−30 dBc	_____	11

Instruments with Option 006 (cont'd)				
Receiver Harmonics				
Instrument Stop Frequency	**Harmonic**	**Specification**	**Measured Value**	**Step**
3.0 GHz	B: 2nd	−15 dBc	_____	13
2.0 GHz	B: 3rd	−30 dBc	_____	14
3.0 GHz	A: 2nd	−15 dBc	_____	15
2.0 GHz	A: 3rd	−30 dBc	_____	16

SYSTEM TEST (THRU/RECEIVER CALIBRATION AND SOURCE CALIBRATION)

This procedure assumes you are not using an HP Test Set (electrical) connected to your system. It assumes you are making either an O/O, O/E, or an E/O measurement. It also assumes that the HP 8702 is operating properly as a stand-alone electrical analyzer.

Before Performing the Test

Verify that the DUT is not causing the problem.

- Repeat the sequence of events (key presses) that led to the problem. Check every connection in the system to determine at which point the failure symptom appears.
- If the problem is a measurement inaccuracy, repeat the sequence of events and re-measure a similar known good device. Or, use any of the example measurements in the *User's Guide* to verify that the problem is not due to the DUT.

Procedure

This procedure uses the HP Lightwave Receiver calibration data to measure the response of the HP Lightwave Source. This test will verify that the system is operating properly and that all lightwave components are functioning.

With the Lightwave Source and Lightwave Receiver disconnected from the system (shown in the figure below), connect the RF cables together to form an electrical thru.

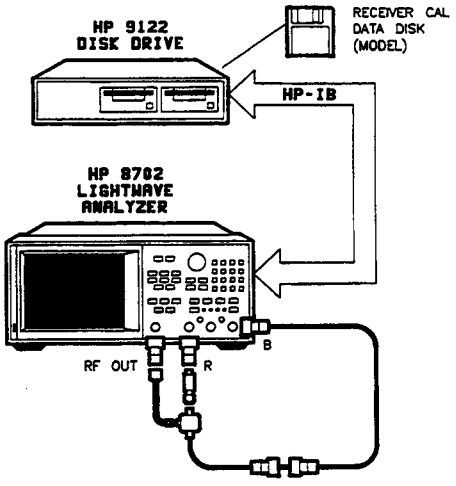


Figure 1. System Test Setup

1. Press:

   [PRESET], **[MEAS]**, ***[B/R]***
   [CAL], ***[DEVICE TYPE]***, ***[E/O]***, ***[RETURN]***
   [CAL KITS & STDS], ***[RECEIVER COEFF]***, and change it to ***[RCVR DISK]***.

2. Insert the Receiver Cal Data disk in the disk drive and press:

   [LOAD RCVR DISK] and ***[READ FILE TITLES]***. The HP 8702 will read the receiver data, and the filename corresponding to your instrument's serial number will be displayed on the CRT softkey area. Load the receiver data by pressing:

   [LOAD xxxxxxx]

3. After the data is loaded press ***[DISK STD → MEMORY]***

   At this point, you can check the receiver data by pressing:

   [DISPLAY] and to view the data, ***[MEMORY]***. The receiver's modulation transfer characteristics (101 point data) will be displayed on the CRT. You should see the approximate 20 dB gain (rolls off to 10 dB) of the receiver as shown in the plot below (HP 83410A). Other receivers have a different response.

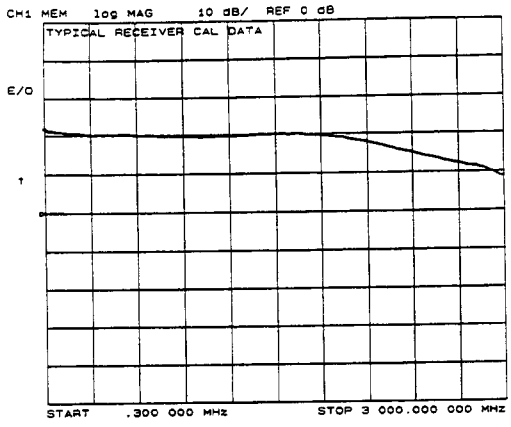


Figure 2. Typical Receiver Cal Data

4. Return the display to data, press ***[DATA]***.

   The trace should now be a flat line at about 20 dB across the band.

5. Press **[CAL]**, ***[CALIBRATE MENU]***, ***[RESPONSE]*** and ***[THRU/RCVR]***.

   After the HP 8702 makes the measurement, it will beep and underline the THRU/RCVR. Press:

   [DONE: RESPONSE]

   The display should now show the inverse trace from the receiver data (below the 0 dB reference). This is the system response (E/E) with the receiver response removed. Verify that the HP 8702 firmware and calibration feature is functioning, press:

   [DISPLAY] and ***[DATA and MEMORY]***. The display should be similar to the one below, where a mirror-like image of the receiver cal data now includes the trace above the 0 dB reference. This is the receiver cal data (HP 83410A) that is in memory. Other receivers will have a different trace.

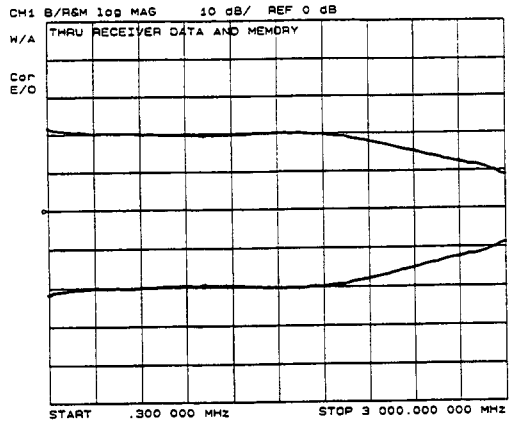


Figure 3. Thru Receiver Data and Memory Trace

6. Connect the Lightwave Source and Lightwave Receiver as shown in the figure below:

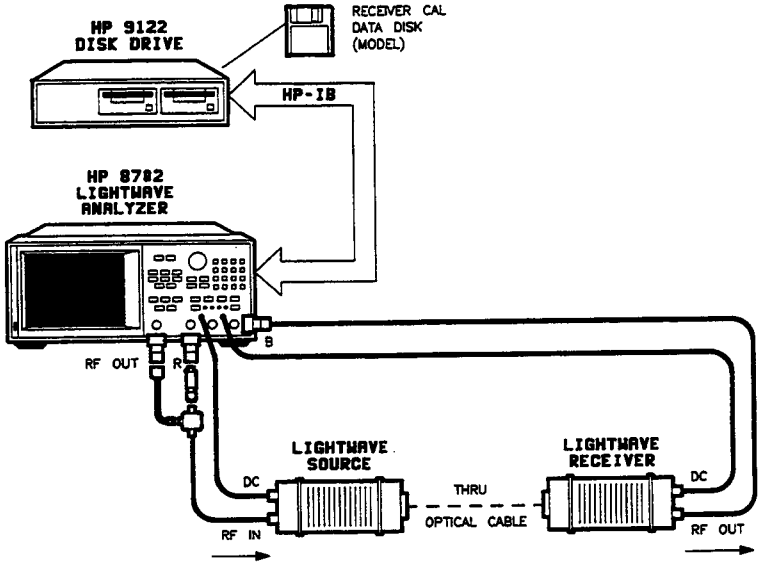


Figure 4. System Test Setup

7. The response on the CRT should now show the THRU/RECEIVER calibrated response of the Lightwave Source including the effects (loss) of the optical cables. Plot the response and keep a copy of the measurement for comparison later.

   Because the HP source response is known (disk data), this measurement should not only verify that the system is making good error corrected measurements, but also verify that the source and receiver are working.

   Turn the THRU/RECEIVER correction OFF, press: **[CAL]** ***[CORRECTION OFF]***.

   Press:

   [CAL] ***[CAL KITS & STDS]*** and select the source disk feature. If necessary, press: ***[SOURCE COEFF] [SRC DISK]***

   Insert the Lightwave Source Cal Data disk in the drive, and press:

   [LOAD SRC DISK] [READ FILE TITLES] [LOAD xxxxxxx] and after the disk is loaded, ***[DISK STD → MEMORY]***

   After the data is in memory, press: **[DISPLAY]** ***[MEMORY]***.

   The CRT now shows the source disk data in memory. You can press ***[DATA and MEMORY]***, and the CRT will show the data trace as the uncalibrated system response.

8. Now verify that the measured source transfer characteristics are similar to the disk data. Perform a SOURCE response calibration, press:

   [CAL] ***[DEVICE TYPE] [E/O] [RETURN] [CALIBRATE MENU] [RESPONSE] [SOURCE]***, and after the beep, ***[DONE: RESPONSE]***.

9. Compare the traces, press: **[DISPLAY]** ***[DATA and MEMORY]***, and to view the response better, **[SCALE REF]** ***[AUTO SCALE]***. The CRT should now display both traces. The plot below shows both traces for an HP 83400A. Other sources will be different.

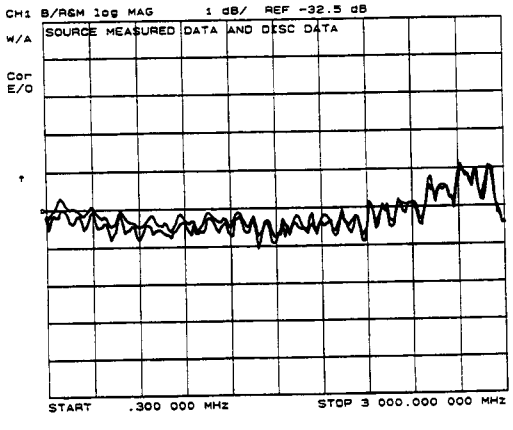


Figure 5. HP 83400A Measurement and Disk Cal Data

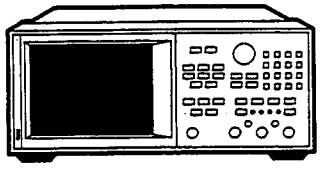
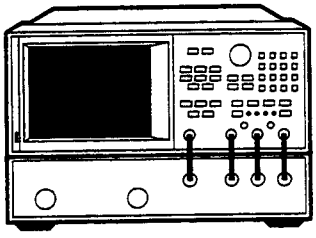
10. Compare the two traces with the source trace data made using the THRU/RECEIVER calibration in the previous steps.

    If all of the traces are similar, within about one or two dB, depending upon the drift, cable errors, etc., the system is probably working.

    If all three traces are not within a few dB, check all the optical connectors and cables and repeat the procedure. If the traces are still not similar (stable and repeatable within about one or two dB), refer to the Lightwave Source and Receiver manuals (accessories) to test their individual performance using their Performance Tests.

    For reflection measurement problems, using an HP Optical Coupler, refer to its manual for testing.

CHECKING INSTRUMENT OR SYSTEM PERFORMANCE

 **To test the INSTRUMENT by itself**	**ACCOMPLISH THIS**	 **To test the SYSTEM**
Do: Performance Tests Includes: • Basic HP 8753 and 8702 tests (all analyzers) • Supplemental HP 8753B/C tests (depends on model and option) **Refer to: Performance Tests Section**	⬅ Any Return-to-HP Standard Calibration On-Site Standard ➡ Calibration ⬅ MIL-STD 45662 ➡ Calibration	**Do: On-Site Verification** Includes: • System Verification (HP 8753) • System Tests (HP 8753) • Lightwave System Verification (HP 8702). **Refer to: On-Site Verification Section** *On-site services may not be available in all locations.
Do: Operation Verification Tests Includes: • Subset of 5 Performance tests **Refer to: Performance Tests Section**	⬅ Verify to 90% level of confidence that instrument meets specifications.	
Do: Operator's Check (HP 8753) Stand-Alone Check (HP 8702) **Refer to: Troubleshooting Section**	⬅ 80% confidence that analyzer is operating	

INTRODUCTION

To see how *Performance Tests* compares with *On-Site Verification*, see *Verification Considerations*.

Specific instruments are performance tested as follows:

Instrument	Performance Tests[1]
HP 8753A	(1) Basic HP 8753 and HP 8702 Tests
HP 8753B/C	(1) Basic HP 8753 and HP 8702 Tests (2) HP 8753B/C Minimum R Level for External Source
HP 8753B/C with options	(1) Basic HP 8753 and HP 8702 Tests (2) HP 8753B/C Minimum R Level for External Source Test (3) appropriate HP 8753B/C Option xxx tests
HP 8702A/B	(1) Basic HP 8753 and HP 8702 Tests

1. See Table 1.

VERIFICATION CONSIDERATIONS

There are two distinct methods to verify that the analyzer is operating as specified: *On-Site Verification* and *Performance Tests*. The following table describes these two approaches and their relative advantages.

Choose the method that meets your needs. It is not necessary to perform both.

Comparison of On-Site Verification and Performance Tests

On-Site Verification	Performance Tests
Description:	
On-Site Verification consists of System Verification and System Tests. System Verification measures a set of standards with the user's system and compares the results with traceable data. System Tests measures a few key performance specifications with additional test equipment.[1]	*Performance Tests* measure all warranted performance specifications with additional test equipment.[1]
What Specifications Are Tested:	
Total system-level uncertainty limits after accuracy enhancement[2] (and a few instrument specifications.)	Warranted instrument-level specifications of the analyzer.[3]
Where HP Performs The Test:	
On-site, at the user's location (where available).	At return-to-HP Service Centers.
What Equipment Is Tested:	
A complete 7 mm system, consisting of analyzer, test set, cables, calibration kit.[4]	The analyzer itself.
When Each Method Should Be Used:	
• Analyzer normally used in defined[4], integrated system.	• Analyzer normally used alone or in an undefined[4] system.
• System used with accuracy enhancement.	• Instrument normally used without accuracy enhancement.
• System usually makes ratioed measurements.	• Analyzer makes non-ratioed or absolute amplitude measurements.
• User prefers traditional microwave network analyzer method.	• User prefers traditional lower-frequency, stand-alone method.
• Subtle, system performance problems must be troubleshot.	• Gross, solid failure must be troubleshot.

1. See Table 1 in Service and Equipment Overview for details.
2. See System Performance section of Operating Manual.
3. See Instrument Specifications section of Operating Manual.
4. Defined on-site supportable systems are listed in On-Site Verification.

DESCRIPTION

This section consists of step-by-step tests that confirm the performance specifications coded S-1 in the instrument specifications table. That table is part of the *General Information and Specifications* section of the *Operating Manual*.

The performance tests are arranged for convenience, with the fastest, most generic tests placed first. However, tests may be performed in any order or singly. Performance tests for most instruments can be completed in about six hours, not including instrument warm-up time of one hour. They are listed in Table 1.

Table 1. Performance Tests

Page	Test
	Basic HP 8753 and HP 8702 Tests
5	Frequency Range and Accuracy
7	Minimum R Level
9	Receiver Noise Level[1]
11	Input Crosstalk
14	Trace Noise
16	Frequency Response[1]
18	Absolute Amplitude Accuracy
21	Input Impedance
25	Automated Performance Tests Introduction
36	Output Power (automated)[1]
41	Spectral Purity (automated)[1]
50	Dynamic Accuracy (automated)[1]
	Supplemental HP 8753B/C Tests
63	HP 8753B/C Minimum R Level for External Source
65	HP 8753B/C Option 002 Absolute Amplitude Accuracy
67	HP 8753B/C Option 002 and 006 Absolute Amplitude Accuracy
69	HP 8753B/C Option 002 Source and Receiver Harmonics
72	HP 8753B/C Option 006 Minimum R Level
74	HP 8753B/C Option 006 Input Crosstalk
78	HP 8753B/C Option 006 Frequency Response
82	HP 8753B/C Option 006 Compression
84	HP 8753B/C Option 006 Absolute Amplitude Accuracy
86	Optional Frequency Offset Mode (not required)
89	Performance Test Record
92	HP 8753B/C Supplemental Performance Test Record

1. **Operation Verification Tests:** perform this subset of five tests to verify to a 90% confidence level that the instrument meets its specifications.

MANUAL AND SEMI-AUTOMATED PERFORMANCE TESTS

All manual and semi-automated tests must be performed to completely verify instrument performance. Most performance tests are manual; three are semi-automated and require a controller. Those three tests are the most tedious and (therefore) have no manual equivalents.

The test software is supplied on a 3.5 inch disk with single-sided format and packaged inside this manual.

Run the Operator's Check prior to the performance tests. These quick, automated internal checks may save time by indicating an instrument fault before time is invested doing performance tests. The Operator's Check is documented in *Troubleshooting and Block Diagram.*

The table of recommended test equipment in the *Service and Equipment Overview* section lists the equipment needed to perform all of the performance tests. Equipment lists for individual tests are provided in each performance test.

Some tests require common RF adapters that are not shown or listed. Adapters are called out when they are used in unique setups. In many test setups, an asterisk (*) is shown next to RF paths between connectors that are to be directly connected without using a cable.

CALIBRATION CYCLE

Once a year (at least) is the recommended calibration cycle.

PERFORMANCE TEST RECORD

The *Performance Test Record* at the end of this section is provided to record the values measured in each of the manual performance tests. The record for all semi-automated tests is generated by a printer during those tests.

IF THE INSTRUMENT FAILS A TEST

If a test fails, refer to the *If The Instrument Fails This Test* paragraph at the end of the procedure for troubleshooting hints or references to other manual sections to help resolve the problem.

After any performance test failure, follow the system-level troubleshooting procedures. Make sure that the test equipment used in each test conforms to its own published specifications and that all connectors are clean. Refer to the *microwave connector care* information in the operating manual for specific information on the use, cleaning, mating, and gaging of type-N connectors, as well as precision 7 mm, SMA, and precision 3.5 mm connectors.

The table of *Related Service Procedures* located in the *Post-Repair Procedures* section shows which performance tests and adjustments are interactive. Use it to determine which other performance tests, if any, need to be done after adjustment or repair of the instrument.

Frequency Range and Accuracy Performance Test

SPECIFICATIONS

Frequency Range: 300 kHz to 3 GHZ + frequency accuracyFrequency Accuracy: ±10 ppm (25°C ± 5°C)

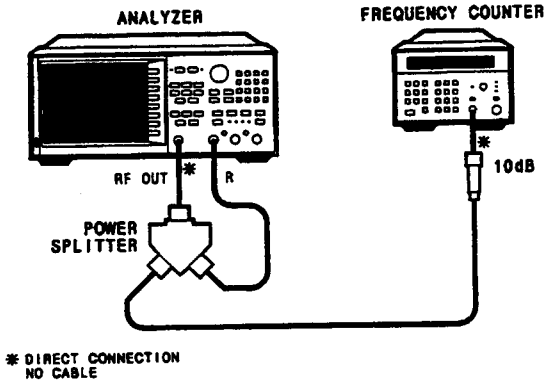


Figure 1. Frequency Range and Accuracy Test Setup

EQUIPMENT

Frequency counter	HP 5343A
50 ohm power splitter	HP 11667A option 001
10 dB attenuator	HP 8491A option 010
RF cable set	HP 11851B

DESCRIPTION AND PROCEDURE

This tests the instrument's frequency accuracy over its entire frequency range. Frequencies in each of the analyzer's 11 internal sub-bands are checked due to its harmonic mixing scheme. Warm-up time: one hour.

1. Connect the equipment as shown in Figure 1. Press **[PRESET] [MENU]** ***[CW FREQ]***.
2. Press **[3] [0] [0] [k/m]** to select a CW frequency of 300 kHz. Record the counter reading on the *Performance Test Record*.
3. Repeat step 2 for each of the frequency settings listed on the *Performance Test Record*. The tolerance and measurement window are different for each frequency selected.

IF THE INSTRUMENT FAILS THIS TEST

If any frequency measured is close to specification limits (either in or out of specification), check the time base accuracy of the counter used.

If the analyzer fails by a significant margin at all frequencies (especially if the deviation increases with frequency), the master time base probably needs adjustment. In this case, refer to the frequency accuracy adjustment in *Adjustments*. The reference assembly VCO tune adjustment also affects frequency accuracy.

Refer to the *Source* section for related troubleshooting information.

Minimum R Level Performance Test

SPECIFICATIONS

Minimum R level for phase lock: −35 dBm

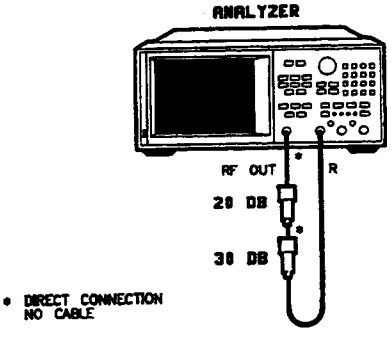


Figure 2. Minimum R Level Test Setup

EQUIPMENT

20 dB attenuator	HP 8491A option 020
30 dB attenuator	HP 8491A option 030
RF cable	part of HP 11851B cable set

DESCRIPTION AND PROCEDURE

Source phase lock is achieved by sampling the signal at the R input. The phase detection circuitry must receive sufficient power from input R for proper source operation. The specification states that the instrument should have enough power to phase lock if the R input level is at least −35 dBm.

This test checks the minimum R input power level at which phase lock can be achieved. At each CW frequency, the R input power is set to approximately −55 dBm, the minimum level using the given setup. If no phase lock errors are present, the actual R input level detected by the analyzer is recorded as the minimum R level. If phase lock errors are present, the source output power is increased until phase lock is achieved. The R input level at which this occurs is then determined to be the minimum R level.

Warm-up time: one hour

1. Connect the equipment as shown in Figure 2 and press **[PRESET]**.

HP 8702A/B ONLY: Press **[CAL]** ***[DEVICE TYPE] [E/E].***

2. On the HP 8753, press **[MEAS]** ***[R]***. On the HP 8720, press **[MEAS]** ***[INPUT PORTS] [R]***.

3. Press **[MKR FCTN]** ***[MKR SEARTH] [TRACKING ON] [SEARCH: MAX]*** to observe the maximum value of the R input signal.

4. Press **[MENU]** ***[POWER]*** **[-5] [x1]** to set the source power to -5 dBm.

5. Press **[MENU]** ***[CW FREQ]*** **[300] [K/m]** to set the RF output frequency to 300 kHz CW. Check the display for phase lock error messages. If none are present, record the marker value readout in the upper right corner of the display in the Performance Test Record.

If phase lock errors are present, press ***[POWER]*** and use the up-arrow key to increase the output power by 1 dB. Wait a couple of seconds until the sweep indicator (an up-arrow) appears to the left of the graticule to make sure that the analyzer has had time to take a new sweep. Continue increasing the power until the phase lock error messages disappear. Then record the marker value in the Performance Test Record. The value should be less than −35 dB.

6. Repeat steps 4 and 5 for the other CW frequencies listed in the Performance Test Record.

IF THE INSTRUMENT FAILS THIS TEST

Check the flexible RF cable, W8, between the R sampler assembly and the A11 phase lock assembly. Most of the cable should rest on top of the sampler assemblies, not next to the A11 phase lock assembly.

Check the R sampler by substituting the A sampler. Move cable W8 to the A sampler, and use only 10 dB of attenuation between RF OUT and input A. Repeat the test, but press **[MEAS]** ***[A]*** in step 3. If the performance test still fails, suspect the A11 assembly.

Related adjustment: high/low band adjustment.

To troubleshoot: see *Source*.

Receiver Noise Level Performance Test

SPECIFICATIONS

Noise Level (Inputs A,B): −90 dBm (3 kHz IF bandwidth) − 100 dBm (10 Hz IF bandwidth)

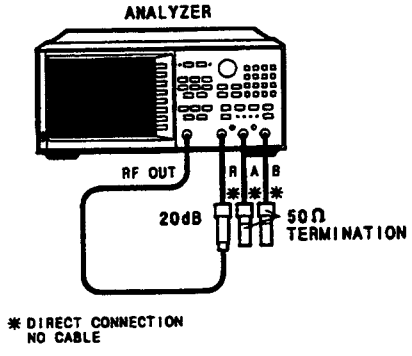


Figure 3. Receiver Noise Level Test Setup

EQUIPMENT

20 dB attenuator	HP 8491A option 020
50Ω termination (2)	HP 908
ARF cable	part of the HP 11851B cable set

DESCRIPTION AND PROCEDURE

This test determines the receiver noise level (noise floor), the ultimate limit of receiver sensitivity. Linear format is used to avoid skewing the data with the marker statistics function. Input R is not tested as it is used for phase locking the source. Warm-up time: one hour.

1. Connect the equipment as shown in Figure 3 and press **[PRESET] [MENU]** ***[POWER]*** **[-] [1] [0] [x1] [MKR FCTN]** ***[STATS ON]*** to set up the instrument. When ***[STATS ON]*** is pressed, *mean*, *s.dev*, and *p-p* values will appear.

HP 8702A/B ONLY: Press **[CAL]** ***[DEVICE TYPE] [E/E]***.

2. Press **[MEAS] [A] [FORMAT]** ***[LIN MAG]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input A 3 kHz IF BW trace *mean* value on the *Performance Test Record.* The *Record* shows the specification in both dBm and μU. U (units) are related to volts and are defined by the equation: power (dBm) $= 20 \log_{10}$ (Linear Magnitude measured value)

   (Pressing **[SCALE REF]** ***[AUTO SCALE]*** will bring the trace into view.)

3. Press **[MEAS]** ***[B]*** **[FORMAT]** ***[LIN MAG]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input B 3 kHz IF BW trace *mean* value on the *Performance Test Record.*

4. Press **[AVG]** ***[IF BW]*** **[1] [0] [x1]** to select an IF bandwidth of 10 Hz. Disregard the CRT message "SWEEP TIME INCREASED". Press **[MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input B 10 Hz IF BW trace mean value on the *Record.*

5. Press **[MEAS] [A] [MENU]** ***[TRIGGER MENU] [SINGLE]*** and note the input A 10 Hz IF BW trace mean value on the *Record.*

IF THE INSTRUMENT FAILS THIS TEST

Suspect: A10 digital IF assembly, if both inputs fail.

Related adjustment: ADC linearity correction constants.

To troubleshoot: see *Receiver.*

Input Crosstalk Performance Test

SPECIFICATIONS

Input Crosstalk (10 Hz IF bandwidth): −100 dB 300 kHz to 1 GHz−90 dB from 1 GHz to 3 GHz

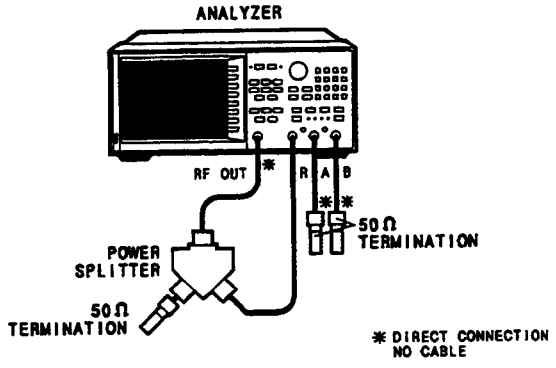


Figure 4. R–into–A and R–into–B Input Crosstalk Test Setup

EQUIPMENT

50Ω power splitter	HP 11667A option 001
50Ω termination (3)	HP 908A
20 dB attenuator	HP 8491A option 020
50W RF cable set	HP 11851B

DESCRIPTION AND PROCEDURE

This tests the signal leakage interference between inputs when one input is driven and another terminated. As input R is used for phase lock, A-into-R and B-into-R crosstalk is not tested.

In the following procedure, an RF signal is connected to input R to check input R crosstalk (R-into-A, and R-into-B). An RF signal is then connected to input B to test input B crosstalk (B-into-A). Lastly, an RF signal is connected to input A to test input A crosstalk (A-into-B).

Ratioed measurements are used to compensate for any frequency response effects.

R into A Crosstalk

HP 8702A/B ONLY: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]***. Do not press PRESET again in the next step.

1. Connect the equipment as shown in Figure 4 and press **[PRESET] [SCALE REF] [2] [5] [x1] [MENU]** ***[POWER]*** **[6] [x1] [AVG]** ***[AVERAGING FACTOR]*** **[5] [x1]** ***[AVERAGING ON] [IF BW]*** **[1] [0] [x1]** to set up the instrument. Disregard the "SWEEP TIME INCREASED" message on the CRT.

   Then press **[MKR FCTN]** ***[MKR SEARCH ON] [TRACKING ON] [SEARCH: MAX]***.

2. Press **[STOP] [1] [G/n] [MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. At the end of the fifth sweep, read the number one marker value (visible in the upper right-hand corner of the CRT, after "1: "). Write this value on the *Performance Test Record*.

3. Press **[START] [1] [G/n] [STOP] [3] [G/n]** ***[NUMBER of GROUPS]*** **[5] [x1]**. At the end of the fifth sweep, record the marker value on the *Record*.

R into B Crosstalk

4. Press **[MEAS] [B/R] [MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. At the end of the fifth sweep, record the marker value.

5. Press **[START] [.] [3] [M/u] [STOP] [1] [G/n]** ***[NUMBER of GROUPS]*** **[5] [x1]**. At the end of the sweeps, record the marker value.

B into A Crosstalk

6. Connect the equipment as shown in Figure 5 and press **[MEAS] [A/B] [MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. At the end of the sweeps, record the marker value.

7. Press **[START] [1] [G/n] [STOP] [3] [G/n]** ***[NUMBER of GROUPS]*** **[5] [x1]**. At the end of the sweeps, record the marker value.

A into B Crosstalk

8. Reconfigure the instrument by moving the 50W load from input A to input B and moving the cable from input B to input A.

   Press **[MEAS]** ***[A/R]*** **[AVG]** ***[AVERAGING OFF]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]***. At the end of the sweep, press **[DISPLAY]** ***[DATA->MEMORY] [DATA/MEM]*** **[MEAS]** ***[B/R]*** to set up a B/A measurement (by ratioing out the R data).

   Press **[AVG]** ***[AVERAGING FACTOR]*** **[5] [x1]** ***[AVERAGING ON]*** **[MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. At the end of the sweeps, record the marker value.

9. Press **[START] [.] [3] [M/u] [STOP] [1] [G/n] [MEAS]** ***[A/R]*** **[AVG]** ***[AVERAGING OFF]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]***. At the end of the sweep, press **[DISPLAY]** ***[DATA->MEMORY] [DATA/MEM]*** **[MEAS]** ***[B/R]*** to set up the second B/A measurement.

   Press **[AVG]** ***[AVERAGING FACTOR]*** **[5] [x1]** ***[AVERAGING ON]*** **[MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. At the end of the sweeps, record the marker value.

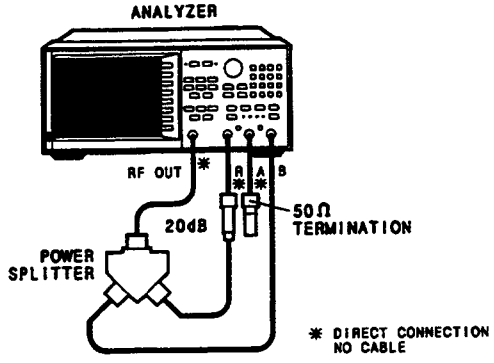


Figure 5. B–into–A Input Crosstalk Test Setup

IF THE INSTRUMENT FAILS THIS TEST

Suspect: loose external RF test cable and termination connectors. Inspect all cables for signs of damage, wear, or faulty shielding.

Remove the analyzer top cover and tighten any loose SMA connector nuts on the four semi-rigid cables located between the A4/5/6 sampler/mixer assemblies and the front panel type-N connectors. These connectors should be torqued to 8 pound-inches.

Tighten any loose screws on the A4/5/6 sampler/mixer assembly covers, and on the A7 pulse generator assembly. Inspect the shielding clips on the A5 sampler/mixer and A7 pulse generator. Inspect the shielding posts on the A10 digital IF board assembly.

Related adjustments: none.

To troubleshoot: see *Receiver*.

Trace Noise Performance Test

SPECIFICATIONS

Trace Noise: (A/R, B/R, A/B, at −10 dBm, 3 kHz bandwidth)

Magnitude: <0.006 dB rms

Phase: <0.035° rms

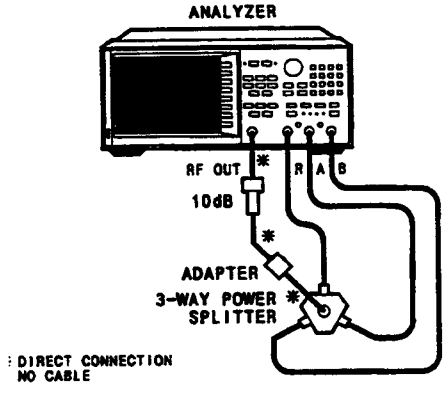


Figure 6. Trace Noise Test Setup

EQUIPMENT

50Ω three-way power splitter	HP 11850C
10 dB attenuator	HP 8491A option 010
50Ω RF cable set	HP 11851B
Adapter, type N (m)/(m)	HP part number 1250-1475

DESCRIPTION AND PROCEDURE

This test measures trace noise on a CW signal in ratio mode. The test is done in CW in order to eliminate any effects of frequency response. It is tested at 3 GHz because conditions are the noisiest at that frequency.

HP 8702A/B ONLY: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]***. Do not press PRESET again in the next step.

1. Connect the equipment as shown in Figure 6 and press **[PRESET] [MENU]** ***[POWER]*** **[1] [0] [x1] [MENU]** ***[NUMBER of POINTS]*** **[1] [6] [0] [1] [x1]** ***[CW FREQ]*** **[3] [G/n]** to set up the instrument. Then press **[MKR FCTN]** ***[STATS ON]*** to enable marker statistics.

   The standard deviation trace value is displayed as a marker statistic (s.dev) in the upper right-hand corner of the CRT. It corresponds directly to rms.

   Record the s.dev value on the *Performance Test Record*.

2. Press **[MEAS]** ***[B/R]*** and record the s.dev value on the *Record*.

3. Press ***[A/B]*** and record the s.dev value on the *Record*.

4. Press **[FORMAT]** ***[PHASE]*** and record the s.dev value on the *Record*.

5. Press **[MEAS]** ***[B/R]*** **[FORMAT]** ***[PHASE]*** and record the s.dev value.

6. Press **[MEAS]** ***[A/R]*** **[FORMAT]** ***[PHASE]*** and record the s.dev value.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: the A10 digital IF assembly.

Related adjustments: none.

To troubleshoot: see *Receiver*.

Frequency Response Performance Test

SPECIFICATIONS

Magnitue Ratio Accuracy (A/R, B/R, A/B): ±0.5 dB (−10 dBm on all inputs)
Phase Frequency Response (A/R, B/R, A/B): ±3° from linear phase (−10 dBm on all inputs)

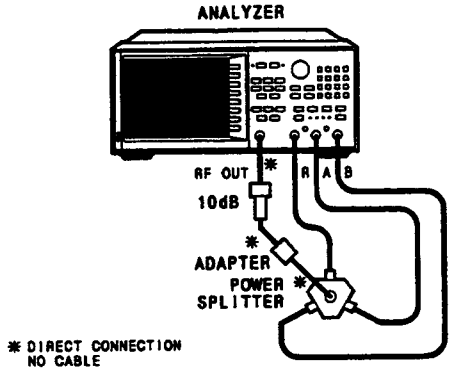


Figure 7. Frequency Response Test Setup

EQUIPMENT

50Ω Three-Way Power Splitter	HP 11850C
10 dB Attenuator	HP 8491A option 010
50WRF Cable Set	HP 11851B
Adapter, type-N (m)/(m)	HP part number 1250-1475

DESCRIPTION AND PROCEDURE

This performance parameter is a typical characteristic but not a guaranteed specification; testing it is recommended but not required.

This test determines the magnitude ratio accuracy for each pair of inputs by measuring the peak-to-peak variation of the ratioed trace. It also determines the phase tracking frequency response, measured as deviation from linear phase. Both magnitude and phase frequency response are tested for A/R, B/R, and A/B input ratios in swept mode. Warm-up time: one hour.

Magnitude Ratio Accuracy

HP 8702A/B ONLY: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]***. Do not press PRESET again in the next step.

1. Connect the equipment as shown in Figure 7 and press **[PRESET] [MENU]** ***[POWER]*** **[1] [0] [x1] [SCALE REF] [.] [1] [x1]** to set up the instrument.

2. Press ***[MKR FCTN] [MARKER ▸REFERENCE]*** **[DISPLAY]** ***[DATA▸MEMORY]*** to store the measured data. A beep indicates that the trace is stored. Reverse the R and A cable connections on the analyzer input ports. Then press ***[DATA and MEMORY]***.

   Visually average the two traces: imagine a trace directly between the two traces. (If both traces are not completely visible, change the scale as required.)

   Record the maximum "averaged" power deviation on the *Performance Test Record*.

3. Press **[DISPLAY:DATA] [MEAS]** ***[B/R]*** and repeat step 2 for B/R, except reverse the B and R input cable connections after storing the trace.

4. Press **[DISPLAY:DATA] [MEAS]** ***[A/B]*** and repeat step 2 for A/B, except reverse the A and B input cable connections after storing the trace.

Phase Ratio Accuracy

5. Press **[PRESET] [MENU]** ***[POWER]*** **[1] [0] [x1] [MKR FCTN]** ***[STATS ON]*** **[FORMAT]** ***[PHASE]*** to set up the instrument.

6. Press **[SCALE REF] [.] [6] [x1]** ***[ELECTRICAL DELAY]*** and turn the RPG to vary the electrical delay until the trace is in the most linear horizontal position. Then press **[MENU]** ***[TRIGGER MENU] [SINGLE]***.

   When the sweep "Hld" notation appears, record the p-p (peak-to-peak) marker statistic on the *Performance Test Record*. The p-p value appears in the upper right-hand corner of the CRT.

7. Press ***[CONTINUOUS]*** **[MEAS]** ***[B/R]*** **[FORMAT]** ***[PHASE]*** and repeat step 6 for B/R phase.

8. Press ***[CONTINUOUS]*** **[MEAS]** ***[A/B]*** **[FORMAT]** ***[PHASE]*** and repeat step 6 for A/B phase.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: the power splitter and RF cables if the phase ratio accuracy measurement fails. Move the RF cables to different ports on the power splitter and re-measure the inputs that failed.

Related adjustments: the sampler diode bias adjustment and the sampler magnitude and phase correction constants.

To troubleshoot: see *Receiver*.

Absolute Amplitude Accuracy Performance Test

SPECIFICATIONS

Absolute Amplitude Accuracy: 300 kHz to 3.0 Ghz ±1 dB

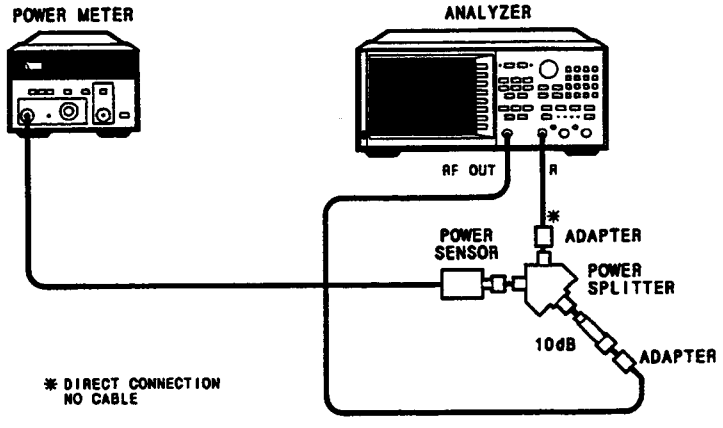


Figure 8. Absolute Amplitude Accuracy Test Setup (Input R)

EQUIPMENT

Power meter	HP 436A or 437 or 438A
Power sensor	HP 8482A (and 8481A, option 006)
50Ω power splitter	HP 11667A option 001
10 dB attenuator	HP 8491A option 010
RF cable set	HP 11851B
Adapter type-N (m) to type-N (m)	HP part number 1250-1475
Adapter type-N (f) to type-N (f)	HP part number 1250-1472

DESCRIPTION AND PROCEDURE

This test measures receiver performance: how well information is transferred from RF to IF and how accurately that information is processed and displayed. The measurement consists of a CW signal applied to a power meter and input R using a 2-way power splitter. The splitter is then connected to inputs A and B in turn and the absolute power level of each input is compared to the earlier power meter reading. The process is repeated at several different frequencies.

NOTE: In the following steps, set the power meter cal factor whenever necessary to compensate for variations in power sensor frequency response.

1. Zero the power meter and set it to measure dBm. Connect the equipment as shown in Figure 8.

   HP 8702A/B ONLY: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]***. Do not press PRESET again in the next step.

   Press **[PRESET] [MEAS]** ***[R]*** **[MENU]** ***[POWER]*** **[6] [x1] [MKR] [MENU]** ***[CW FREQ]*** **[3] [0] [0] [k/m]** to set up the instrument.

2. Record the power meter reading on the *Performance Test Record*.

3. Record the R input power marker reading on the *Performance Test Record*. (The R input power marker reading appears in the upper right-hand corner of the CRT.

   Use the keypad to set the next frequency and repeat steps 2 and 3 for the other frequencies on the *Performance Test Record*.

4. Connect the equipment as shown in Figure 9 and press **[MEAS]** ***[A]*** **[MENU]** ***[CW FREQ]***. For each frequency on the *Performance Test Record*, record the input A power marker reading, as above.

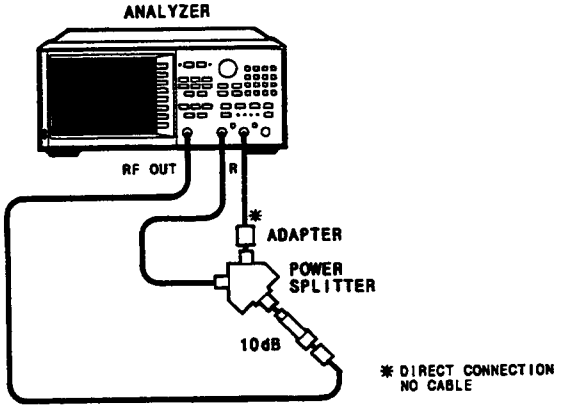


Figure 9. Absolute Amplitude Accuracy Test Setup (Input A)

5. Move the power splitter from input A to input B. Press **[MEAS]** ***[B] [MENU] [CW FREQ]*** and record the input B power marker readings at the same frequencies as above.

6. When all of the readings have been recorded, for each frequency, determine which readings show the greatest variation: power meter versus R, power meter versus A, or power meter versus B. See the first line for an example. Record the greatest variation in the space provided.

   The final results represent the worst-case absolute amplitude accuracy values for all inputs at the selected frequencies.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: poor tracking between the ports of the power splitter if all inputs fail. Suspect source drift if inputs A and B fail this test at any frequency; connect the equipment as shown in Figure 8, set the power level at the frequency of interest, and repeat the test for that input.

Related adjustments: sampler diode bias adjustment, sampler magnitude and phase correction constants.

To troubleshoot: see *Receiver* and *Source*.

Input Impedance Performance Test

SPECIFICATIONS

Input Impedance: 50W nominalReturn Loss: > 20 dB from 300 kHz to 2 MHz > 23 dB from 2 MHz to 2 GHz > 20 dB from 2 GHz to 3 GHz

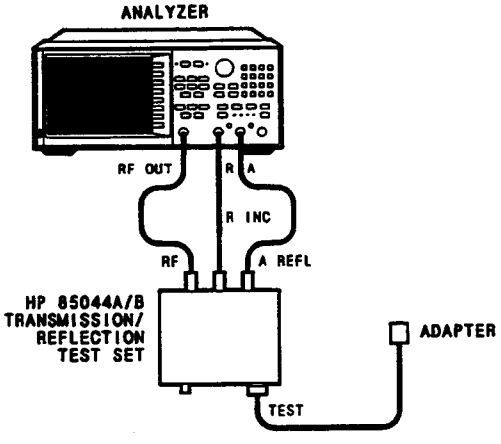


Figure 10. Input B Impedance Test Setup

EQUIPMENT

50Ω test set	HP 85044A or 85046A or 85047A
50W power splitter	HP 11667A option 001
10 dB attenuator	HP 8491A option 010
50W termination	HP 908A
50Ω type-N calibration kit	HP 85032B
50Ω type-N RF cable set	HP 11851B
RF cable	from HP 11857D 7mm cable set

DESCRIPTION AND PROCEDURE

This test measures the return loss of each input using a test set and the other two inputs of the analyzer. A/R is used to measure the input impedance of input B. B/R is used to measure the input impedance of A. A power splitter is used to maintain phase lock when testing input R and A/B is used. Warm-up time: one hour.

1. Connect the equipment as shown in Figure 10. When using the HP 85046A or 85047A test set, connect the test set interconnect cable and use port 1. Set the HP 85044 attenuation to 0 dB. Then press **[PRESET] [MENU]** ***[NUMBER OF POINTS]*** **[1] [6] [0] [1] [x1]** to set up the instrument.

   HP 8702A/B ONLY: Press **[CAL]** ***[DEVICE TYPE] [E/E]***.

2. Press **[CAL]** ***[CAL KIT] [N 50W]*** [RETURN] [CALIBRATE MENU] [S11 1-PORT] to initiate a calibration.

   Connect a type-N (f) open to the adapted test port cable and press ***[OPENS] [OPEN (M)] [DONE: OPENS]***.

   Connect a type-N (f) short to the adapted test port cable and press ***[SHORTS] [SHORT (M)] [DONE: SHORTS]***.

   Connect a type-N (f) 50W termination to the adapted test port cable and press ***[LOAD]***. Then press ***[DONE 1-PORT CAL]*** to complete the calibration sequence (about one-half minute).

3. Remove the 50W termination from the test port cable and connect the cable to the open input port of the analyzer. Press **[SCALE REF]** ***[AUTO SCALE]***.

4. Press **[MKR] [.] [3] [M/m]** to set marker 1 to 300 kHz. Record the marker power level value (seen in the upper right-hand corner of the CRT) in the *Performance Test Record*. Return loss below 2 MHz is tested only at 300 kHz, where it is always greatest.

5. Press ***[MARKER 1]*** **[2] [M/u]** ***[MARKER 2]*** **[2] [G/n]** to set the markers to 2 MHz and 2 GHz. Turn the knob to move marker 2 to the peak value between 2 MHz and 2 GHz. The peak value represents worst-case return loss; record it in the *Performance Test Record*.

6. Press ***[MARKER 1]*** **[2] [G/n]** ***[MARKER 2]*** **[3] [G/n]** to set the markers to 2 GHz and 3 GHz. Turn the knob to move marker 3 to the peak value between 2 GHz and 3 GHz. Record this value in the *Performance Test Record*.

7. Connect the equipment as shown in Figure 11 and press **[PRESET] [MEAS]** ***[INPUT PORTS] [B/R]*** **[MENU]** ***[NUMBER of POINTS]*** **[1] [6] [0] [1] [x1]**. Repeat steps 2 through 6 for input A return loss.

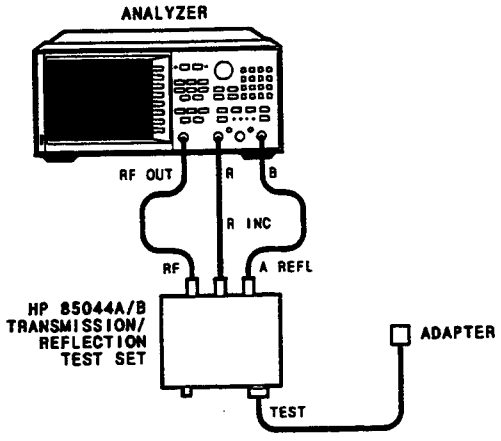


Figure 11. Input A Impedance Test Setup

8. Connect the equipment as shown in Figure 12 and press **[PRESET] [MEAS]** ***[INPUT PORTS] [A/B]*** **[MENU]** ***[NUMBER of POINTS]*** **[1] [6] [0] [1] [x1]**. Repeat step 2 to perform a calibration.

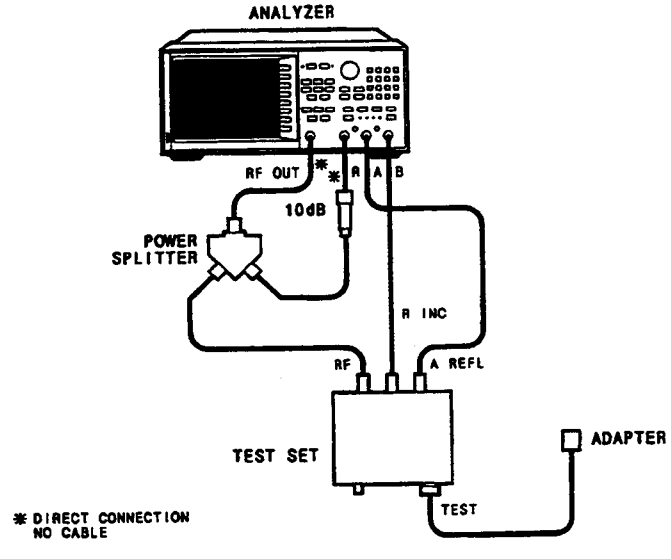


Figure 12. Input R Impedance Test Calibration Setup

9. Connect the equipment as shown in Figure 13 and repeat steps 3 through 6 to measure input R return loss.

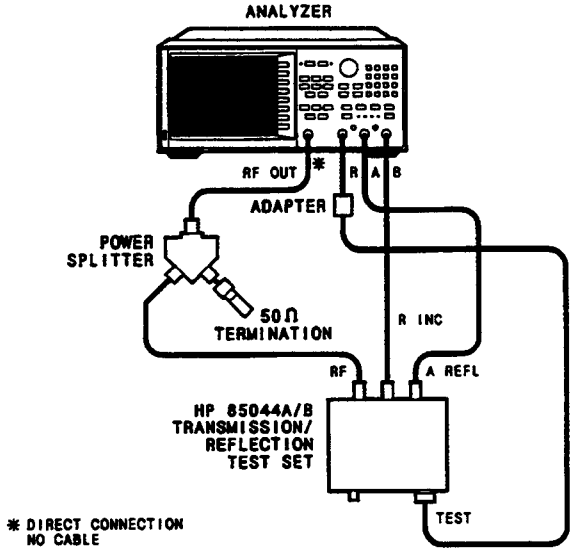


Figure 13. R Input Impedance Test Setup

IF THE INSTRUMENT FAILS THIS TEST

Suspect: damage or excessive wear of the type-N input connectors; check them. Impedance mismatch may also be caused by the sampler, or the semi-rigid coaxial cables connecting the A4/5/6 sampler/mixer assemblies to the front panel type-N connectors.

If no damage is apparent at the input connector, try interchanging sampler assemblies. If the problem goes away, the sampler is defective. If it does not go away, suspect the path from input to sampler.

Related adjustments: none To troubleshoot: see *Receiver*.

Automated Performance Tests

Software Revisions:

A.01.01

A.01.02

INTRODUCTION

NOTE: Read the next few pages before attempting to run the performance test software. This will avert most problems before they arise.

This section of the performance tests contains instructions and setup diagrams for several automated tests. Automated tests require an HP 9000 series 200/300 desktop computer, associated peripherals and the software provided on disk in this manual. These tests do require operator interaction and are best described as semiautomated.

The rest of this section is organized as follows:

SETTING UP THE SYSTEM: This provides hardware and software model numbers for proper system configuration. It also provides instructions for loading the operating system.

SOFTWARE BACK-UP: This defines the files provided with the performance test software, and also provides instructions for disk copying .

GETTING STARTED: This provides instructions for loading the performance test program. The initial menus associated with program setup are common to all tests, and are documented here. Error messages and recovery from error conditions are discussed. For best results, read the material in this section prior to running test software.

TEST PROCEDURES: Each test procedure is documented separately, with a description of the test and the measured specification. A step-by-step procedure is provided which often references the material in *GETTING STARTED*. Test set-up diagrams for each test are provided.

SETTING UP THE SYSTEM

System Hardware Configuration

Controllers. The HP 9000 series 200/300 controllers listed in Table 2 can be used to run the performance tests. Other controllers not listed here may work.

Table 2. HP 9000 Controller Models

Series 200: 216, 226, 236, 220
Series 300: 310

Peripherals. The automated tests require mass storage and a printer. (The required measurement instrumentation is listed in the test procedure.)

There are many compatible disk drives. Software is provided on 3.5 inch floppy disks, formatted single sided so they will be usable in either single or double sided disk drives. The following drives are recommended as a convenience only. Most HP drives will work.

Table 3. Compatible Disk Drives

Model Number	Command Set
HP 9121D	AMIGA
HP 9133A	AMIGA
HP 9133B	AMIGA
HP 9133V/XV	AMIGA
HP 9122D	CS80
HP 9133D/H	CS80
HP 9153A	CS80

A printer is always required to record test results. All test results are output in test record format. Some tests provide additional output in graphical form. This requires a printer capable of accepting raster data (dump graphics) from the controller. Printers that are known to have this capability are listed below.

Table 4. Compatible Printers

HP 2225A ThinkJet
HP 2671G/2673A Thermal Printer
HP 9876A Thermal Line Printer

System Software Requirements

The performance test software requires BASIC versions 3.0 or higher.

To load the BASIC system, locate the BASIC System Disk. Insert the disk into the disk drive and power on the computer. The computer will locate the BASIC operating system and load it into memory.

BASIC versions 3.0 and 4.0 provide a modular operating system architecture. The core of the system is provided on the operating system disk. Additional computation and IO capability is available through the use of code modules called binaries. Binaries are separated into two groups: Language Extensions and Drivers. The automated performance test software requires the following binaries.

Table 5. Required Binaries

Language Extensions	Drivers
ERR GRAPH IO KBD MAT MS	CS80 or DISC (depends on disk) HPIB CRTA or CRTB (depends on CRT)

If you already have a pre-configured BASIC system, you can verify whether or not it contains all of the above binaries. Type:

```
LIST BIN
```
(press **[ENTER]** or **[RETURN]** to execute the command)

All binaries currently contained in memory will be listed to the screen. If any of the required binaries are missing, insert the Drivers disk provided with the system and load the Configure program. Type:

```
LOAD "CONFIGURE"
```

Press **[RUN]** to start the program.

This program lets you select the necessary binary modules and loads them for you. Simply follow the prompts. The program tells you to load the appropriate disk, lists the binaries available on that disk and links that binary into the system upon your command.

You must know what type of disk drive you are using and the command set it uses to select the correct mass storage driver. Drives using CS80 or SS/80 command set require the CS80 binary. (Most drives which read double-sided media use CS80 command set.) Other disks use the AMIGA protocol and require the DISC binary. Table 3 lists the command set used by several HP disk drives. If you are unsure, load both binaries.

Refer to the BASIC user's documentation for more comprehensive instructions on loading the operating system and binaries.

SOFTWARE BACKUP

Disk Files

The performance tests and adjustment software, HP part number 08753-10012, is provided on two single-sided disks. The files contained on these disks are as follows:

DISK 1

PERFTEST	:	main test program
MS_CONFG	:	mass storage configuration file
DEV_CONFG	:	device configuration file
API_ADJ	:	adjustment program for A13 API spurs

DISK 2

power_test	:	output power test subprograms
spur_test	:	spectral purity test subprograms
dyaccytest	:	dynamic accuracy test subprograms
HP436A	:	HP 436A subprograms
HP438A	:	HP 438A subprograms

Making Working Copies

NOTE: Before doing anything else, make working copies of these disks!

The master disks are shipped from the factory write-protected and cannot be written to or initialized in this mode. We recommend you maintain these disks in write-protect mode. During execution, the performance test program must read from and write to one of these disks, therefore it must not be write-protected in normal use. You must copy the master disks to working copies using the instructions below. If the working copy is damaged or lost, the master is always available.

NOTE: When making working copies, do not split up the files contained on Disk 1. They must all reside together on the same mass storage medium. The files on Disk 2 must also reside together on the same mass storage medium.

To copy the master disk, you must initialize a blank disk. Insert a blank disk into the disk drive and type:

```
INITIALIZE ":msus"
```

where *msus* is the address of the drive containing the disk to be initialized. The initialization process takes approximately 60 seconds.

To copy the contents of the master disk to the working disk, follow the instructions below:

Copying to a Hard Disk or Double-Sided Flexible Disk

If you copy both master disks to a storage medium of a larger size, you will have to perform a file-by-file copy instead of copying the entire volume at once. To perform a file copy, follow the instructions below. After typing a command from the keyboard, press **[ENTER]** or **[RETURN]** to execute the command.

1. Insert the master disk into the drive and obtain a directory listing. Type:

   ```
   CAT ":msus"
   ```

   where *msus* is the mass storage unit specifier of the drive containing the master disk.

2. If you are copying to a flexible disk, insert the initialized working disk into the second drive. Type:

   ```
   COPY "filename:master msus" TO "filename:destination msus"
   ```

   where *master msus* is the mass storage unit specifier of the disk drive containing the master disk and *destination msus* is the mass storage unit specifier of the flexible or hard disk drive containing the working storage media.

   Perform step 2 for each file in the master disk directory listing, for each master disk.

   An example: Your system includes an HP 9133H disk drive at HP-IB address 700. The hard disk is unit 0 and the floppy drive is unit 1. (The hard disk can be configured as one large volume or several.) To file copy from the master disk in the floppy drive to volume 3 of the hard disk, the copy command syntax would be:

   ```
   COPY "PERFTEST:,700,1"   TO   "PERFTEST:,700,0,3"
   ```

Copying Flexible Disks with Two Drives

1. Insert the master disk into one drive and the initialized working disk into the other drive.

2. Type:

   ```
   COPY ":source msus" TO ":destination msus"
   ```

   where *source msus* is the mass storage unit specifier of the drive containing the disk you want to copy, and *destination msus* is the mass storage unit specifier of the drive containing the initialized working disk.

   An example: With an HP 9122D dual disk drive at address 700, the master disk in the left drive, and the working disk in the right drive, the copy command syntax would be:

   ```
   COPY ":,700,0"   TO   ":,700,1"
   ```

Copying Flexible Disks with One Drive

When only one drive is available, disk contents must first be copied into memory, then from memory to the destination disk.

1. Type:

   ```
   INITIALIZE ":MEMORY,0"
   ```

2. Insert the master disk into the disk drive.

3. Type:

   ```
   COPY ":msus" TO ":MEMORY,0"
   ```

   where *msus* is the mass storage unit specifier of the disk drive.

4. When the copying is done, remove the master disk from the disk drive and insert an initialized disk into the drive.

5. Type:

   ```
   COPY ":MEMORY,0" TO ":msus"
   ```

   where *msus* is the mass storage unit specifier of the disk drive.

GETTING STARTED

The following text provides instructions on loading the performance test software and interacting with the program. If you wish to run the software while reading the instructions, then you must refer to the test procedure subsection and connect the system as indicated for the test you wish to run. Then follow the procedure for that test. It will refer you back to *GETTING STARTED* for instructions on using the program menus and prompts.

Loading the Performance Test Program

NOTE: Before loading or running programs, set the mass storage unit specifier (MSUS) to the address of the drive containing Disk 1 of the performance test software.

Example: Your system mass storage is an HP 9122 dual disk drive. Insert Disk 1 into the left drive and type:

```
MSI ":,700,0"
```

Press **[RETURN]**.

This command sets the current MSUS to drive 0 of the mass storage device at HP-IB address 700. If the MSUS is not set to the drive containing Disk 1 files, subsequent program errors will occur.

Load the performance test program. Type:

```
LOAD "PERFTEST"
```

Press **[RETURN]**.

When the drive light goes out press **[RUN]**.

During the initialization process, the program searches for the files MS_CONFG and DEV_CONFG at the current MSUS. If these files are not present, an error is reported.

System Configuration Menu

The first menu you see will be the **SYSTEM CONFIGURATION MENU**.

Press **[SELECT]** to select **EDIT MASS STORAGE**.

Edit Mass Storage. Selecting this menu allows you to establish where certain files will reside: CALIBRATION DATA files, and DISK 2 FILES.

Later in the program, you will enter power sensor calibration data. The program will store this data into a file so that it can be easily retrieved at a later date.

Press the **[SELECT]** softkey. Type in the MSUS of the mass storage media where the calibration data should be stored. (Since you made copies of the master disks, and they are no longer write-protected, you can elect to store calibration data files on either of these disks.)

Press **[▼]** and **[SELECT]** to modify the MSUS for volume DISK2 FILES. Type in the MSUS for the mass storage device containing Disk 2.

Example: Your system consists of an HP 9836A and an HP 9122D dual disk drive at HP-IB address 700. Disk 1 resides in unit 0 of your HP 9122. Disk 2 resides in unit 1. You decide to store calibration data on a 5.25 inch floppy in one of the internal drives of the HP 9836. Modify the mass storage config edit menu as follows:

VOLUME LABEL	MSUS	SRM DIRECTORY PATH
CALIBRATION DATA	:INTERNAL,4,1	
DISK2 FILES	:,700,1	

The changes made to the mass storage menu are re-stored into file MS_CONFG and will therefore be in effect the next time the program is run. You won't need to re-edit this menu each time the program is run as long as the system configuration remains the same.

If you are using an SRM system, press the right arrow key **[▶]**. A third column should appear on the screen entitled SRM. This column must contain the directory path for the volume label, and the MSUS column must contain the remote MSUS (":REMOTE").

When you are finished editing the mass storage menu, press **[DONE]**. The program returns to the **SYSTEM CONFIGURATION MENU.**

Press [▼] and **[SELECT]** to select **EDIT DEVICE ADDRESSES.**

Edit Device Addresses. This menu contains four columns, two of which are visible on the screen at any one time. Use the cursor control keys (left, right, up, down) to select different parts of this menu.

NOTE: TO VIEW COLUMNS THREE AND FOUR, PRESS **[▶]**, TWICE. Do NOT edit columns 1 or 2.

This selection allows you to input the actual HP-IB hardware addresses of the equipment you will use in the performance tests. Each instrument address is assumed to be the recommended default address for the instrument with an HP-IB select code of 7:

Printer	701
Power Meter	713
HP 8753A/B/C, HP 8702A/B	716
Spectrum Analyzer	718
Attenuator Driver	728

We recommend you change the address on the instrument itself to comply with these factory recommended defaults. However, if this is not possible, use this menu to edit the program's addresses to match your equipment. When you exit this menu, the changes made will be re-stored to file DEV_CONFG and will be in effect the next time you run the program.

The file DEV_CONFG contains one equipment list for all the tests, so there may be equipment listed in this menu that is not pertinent to the test you are about to run.

If you are using an HP 437A or 438A power meter, edit the model number column for the power meter. By default, this column says HP436A. Change this to HP437A or HP438A (no spaces).

Press **[DONE]** to return to the **SYSTEM CONFIGURATION MENU.**

Press **[DONE]** again to invoke the **PERFORMANCE TEST MENU.**

Performance Test Menu

Select the test you wish to run. The computer will load the subprograms specific to that test. (The computer will expect to find the subprograms at the default MSUS or, if you edited the mass storage configuration screen, at the MSUS you provided for the volume DISK2 FILES. If your disk drive has only one drive available, remove disk 1 now and insert disk 2.)

Each test provides the same main menu choices: **TESTS** and **RESULTS.**

Tests. This selection invokes the necessary setup routines (such as entering calibration factors, etc,) before leading to a menu which allows the selection of individual tests to be run. The setup routines are as follows:

Power Sensor Calibration Factors: You have two choices in this menu: read calibration data from disk, or enter it from the keyboard. If the program has never been run before, there is no calibration data on disk. Select **KEYBOARD ENTRY/EDIT**.

Enter the calibration data from the power sensor label for the frequencies listed in column one. (Enter calibration factors as percentages, for example: 96.7). Press **[SELECT]** and enter the first calibration factor. To enter the second calibration factor, press **[▼]** and **[SELECT]**. Repeat this process for the entire list.

When values are entered from the keyboard, the program asks if you wish to store the data to disk. If so, you are prompted for the last five digits of the power sensor serial number. Enter the number and press **[RETURN]** or **[ENTER]** to complete the input. The program then stores the data in file "8482Annnnn", where nnnnn is the last five digits of the serial number.

When storing calibration data, the program will attempt to create a file on either the default mass storage unit or the MSUS that you input in the mass storage config edit menu for the volume CALIBRATION DATA. If there is no mass storage at that address, an error will occur.

In later executions of the program, you can read this data file from disk by pressing **READ DISK** to load calibration factors into the program.

Attenuator Calibration Data. The dynamic accuracy program is the only routine that requires attenuator calibration data. Enter the actual attenuation value in column two, for all steps of the attenuator. Refer to *Power Sensor Calibration Factors*, above, for instructions on entering/saving these data.

Equipment Initialization. Just before the test menu is displayed, the appropriate power meter subprograms are loaded and the power meter is zeroed and adjusted. Simply follow the prompts on the screen. Any additional equipment is also preset.

Test Routines. Finally, the test menu is displayed. Tests can be run individually or sequentially without interruption (if the test setups are identical). You can rerun these tests as many times as is necessary without repeating all the previous menus. However, results from the previous run will be overwritten.

Results. This selection leads to the **Test Record** menu. All test results can be output to a printer in test record format. Some test results can be output in graphical format. Note that the results menu accesses the analyzer to obtain the serial number of the unit under test.

You can output results as many times as you wish.

Error Recovery

If an error is detected, it is reported to the user with an explanation of the error and the name of the subprogram that detected the error. The error message screen also provides one or more softkeys. The **[ABORT]** softkey returns you to the most recent major menu. Some error messages provide a **[REPEAT]** softkey. Pressing this key will repeat the routine which just detected the error. This is useful in cases, for example, where an HP-IB cable is missing and a device does not respond to the controller. Connect the cable and press **[REPEAT]**.

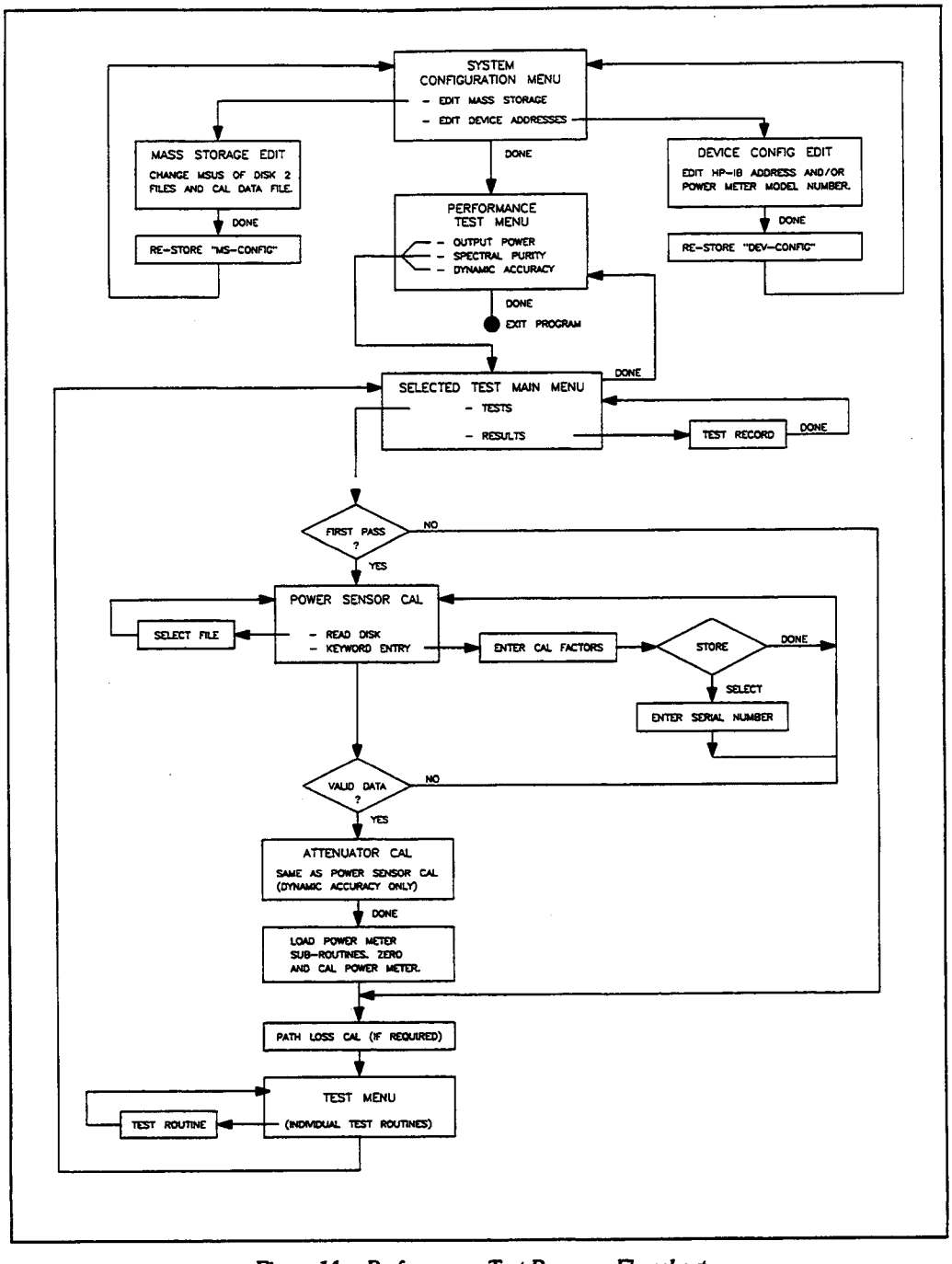


Figure 14. Performance Test Program Flowchart

Output Power

SPECIFICATIONS

Level Accuracy (at +10 dBm output level, 50 MHz)	±0.5 dB
Flatness	±1 dB
Linearity (25°C ±5°C)	
−5 to +15 dBm	±0.2 dB (relative to +10 dBm output level)
+15 to +20 dBm	±0.5 dB (relative to +10 dBm output level)
Range	−5 to +20 dBm

DESCRIPTION

The analyzer source power tests include verification of power level accuracy, power level flatness, power linearity and power range.

These tests are preceded by a path loss calibration procedure that stores frequency response data for the power splitter connected between the analyzer RF OUT port and the power meter.

Power Level Accuracy

This test measures the actual RF output power level of the analyzer when it is tuned to 50 MHz and the power level has been nominally set to +10 dBm.

Power Level Flatness

Power level flatness is tested at six different power level settings, at various frequency points across the range of the analyzer. For example, the power level is first set to −5 dBm. Power meter readings are taken as the analyzer CW frequency is tuned to approximately 30 frequencies from 300 kHz to 3 GHz. The power deviation from the nominal power setting is calculated and stored. This procedure is repeated for power levels of 0, +5, +10, +15, and +20.

The peak-to-peak variation is recorded on the test record for each power level tested. Power flatness can also be plotted on Cartesian coordinates with frequency as the x-axis and power variation as the y-axis. The different power level settings are differentiated by line patterns on the graph.

Power Linearity

Power linearity is tested at five CW frequencies (300 kHz, 50 MHz, 1GHz, 2GHz, and 3 GHz). The analyzer is tuned to a test frequency and the power is incremented from −5 to +20 dBm in 1 dB steps. Power is measured at each step with a power meter. For each test frequency, linearity data is normalized to the power reading taken at +10 dBm.

Power Range

The power output range for the analyzer is specified as −5 to +20 dBm. Actually, the power can be nominally set from −10 to +25 dBm. This allows the user to overcome power flatness and linearity variations by setting the power as necessary to obtain a precise power output level at the extremes of the output range.

Power range is reported on the test record as a simple pass or fail. If the test does fail, however, the points that are out of specification are recorded.

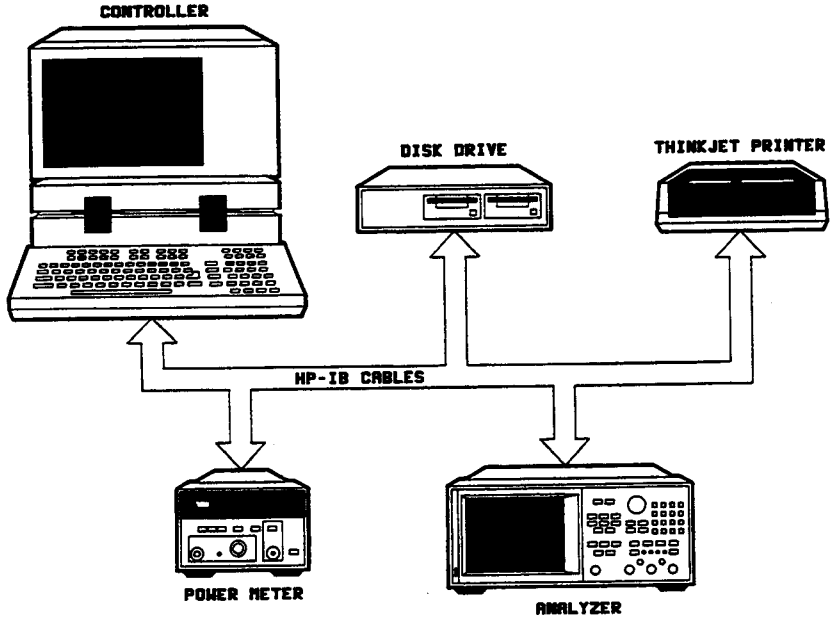


Figure 15. System Configuration for Output Power Tests

EQUIPMENT REQUIRED

Power Meter	HP 436A option 022
Power Sensor	HP 8482A
Power Splitter (2)	HP 11667A Option 001
Attenuator 20 dB (2)	HP 8491A Option 020
Cable Set	HP 11851B

PROCEDURE

1. Connect equipment as shown in Figure 15.
2. Refer to *GETTING STARTED* at the beginning of this section for instructions on loading the BASIC system and the performance test software. Use *GETTING STARTED* to work your way through the **SYSTEM CONFIGURATION MENU**.

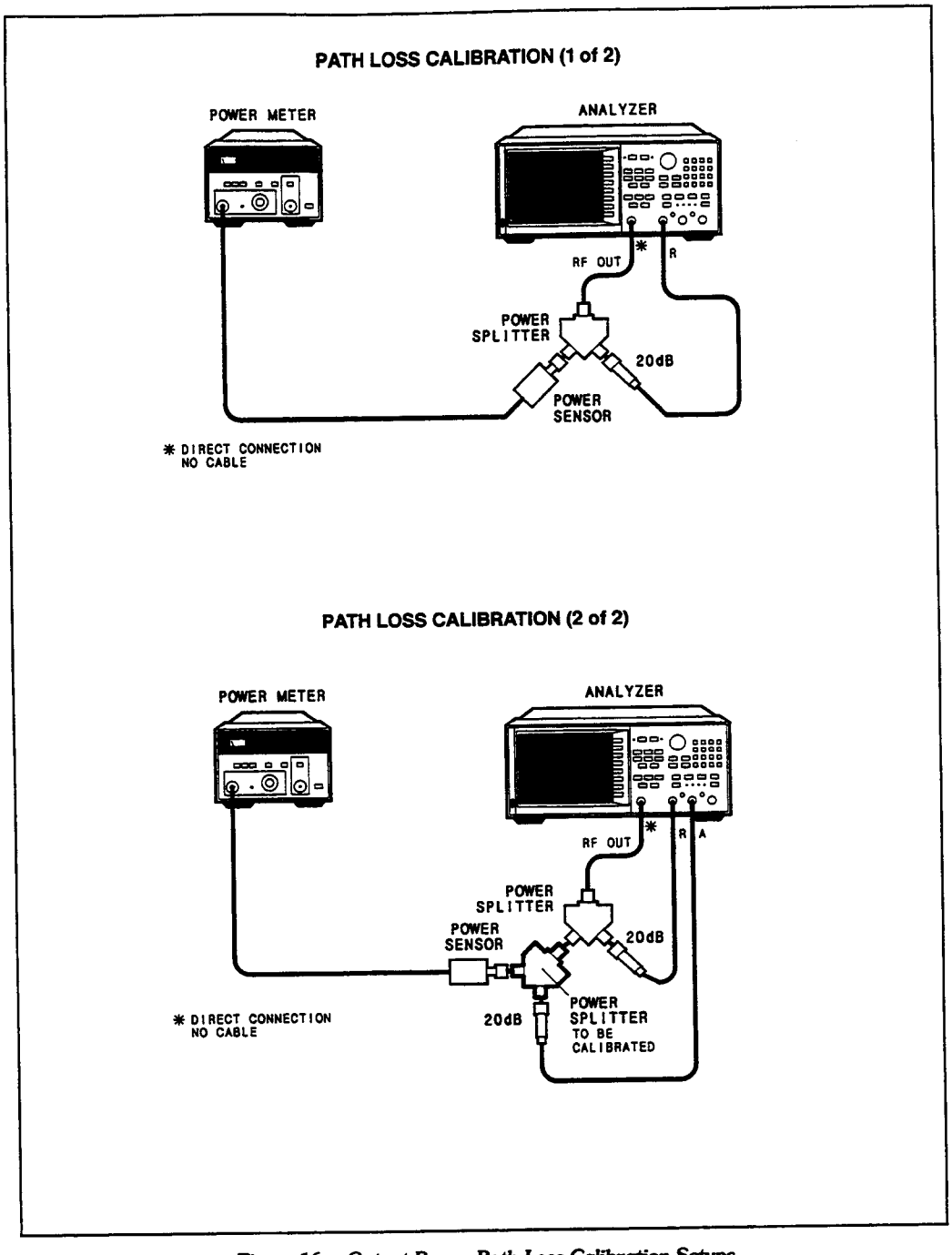


Figure 16. Output Power Path Loss Calibration Setups

3. From the **PERFORMANCE TEST MENU**, select **Output Power**. The program will perform setup routines such as asking for power sensor calibration factors. Refer to *GETTING STARTED* and follow the instructions for this menu.

4. From the **Output Power Tests Menu**, select an individual test or select **ALL TESTS** to run all test routines sequentially without interruption. The first routine selected will invoke the path loss calibration routine. Follow the prompts. They will refer to test setup illustrations on the following pages.

5. You can iterate the tests as many times as you like without repeating the path loss calibration, as long as you do not terminate the output power test subprogram or change the actual device connections between the analyzer and the power meter.

6. Press **[DONE]** when the tests are finished. Now select **RESULTS** to output the test data to the printer. This test also provides plots of power flatness and linearity.

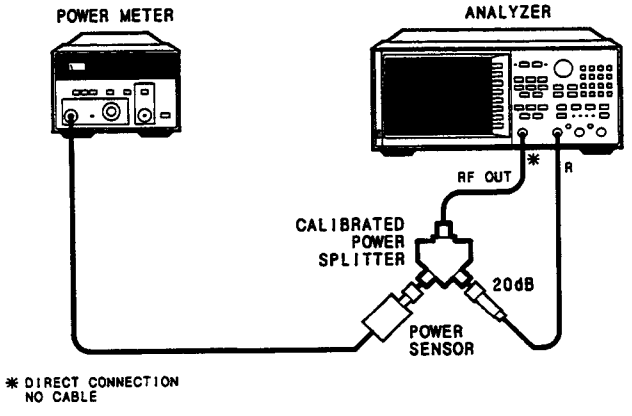


Figure 17. Output Power Performance Test Setup

IN CASE OF DIFFICULTY

Ensure that the power meter and power sensor are operating to specification. Inspect the power splitter connectors. Poor match at these connections can generate power reflections that can cause the analyzer to appear to be out of limits.

Likewise, inspect the analyzer RF OUT connector for damage.

The source relies on internal correction routines for its high accuracy performance. If any test fails, refer to the *Adjustments* section of this manual and perform the *RF Output Power Correction Constants* routine.

If you encounter a catastrophic source failure, refer to *Source* group troubleshooting.

Spectral Purity

SPECIFICATIONS

(With 0 to −10 dBm into the R input)

Harmonics	
(at +20 dBm output level)	−25 dBc
Non-Harmonics	
Mixer-related	
(at +20 dBm output level)	−32 dBc
Other Spurious Signals	
(frequency < 135 MHz)	−60 dBc
(frequency ≥135 MHz)	[−60 + 20 log(f/135 MHz)] dBc

Phase Noise
(10 kHz offset from fundamental in 1 Hz bandwidths)

(frequency < 135 MHz)	−90 dBc
(frequency ≥ 135 MHz)	[−90 + 20 log(f/135 MHz)] dBc

DESCRIPTION

The spectral purity tests measure several phenomena that may appear in the output spectrum of the DUT (Device — network/lightwave component analyzer — Under Test). Each of these phenomena is described and the test method explained.

NOTE: In this performance test, the network analyzer or lightwave component analyzer is refered to as the "DUT" to avoid confusion with the spectrum analyzer.

All measurements are made using the 10 MHz timebase reference from the spectrum analyzer connected to the EXT REF INPUT of the DUT. With this configuration, both the spectrum analyzer and the DUT are phase locked to the same reference frequency which should ideally eliminate frequency offset errors. (If the two analyzers are not phase-locked, the tests will run, but measurements may be invalid.)

Path Loss Calibration

This is not a performance specification but an ancillary routine that determines the frequency response of the power splitter between the DUT RF OUT port and the power meter. Some of the spectral purity performance parameters are specified at +20 dBm output level. In order for power to be set accurately, the path loss to the power meter must be known.

Harmonics

This routine measures the in-band second and third harmonics of the DUT with the power level of the fundamental at +20 dBm.

The DUT's output power variations and the HP 8566 spectrum analyzer's frequency response are avoided using the following measurement technique. To measure the level of the second harmonic of frequency F, the DUT is set to a CW frequency of 2F. The power is set with the power meter to a level of +20 dBm (minus the path loss). The spectrum analyzer is also tuned to a center frequency of 2F, and the amplitude level of the signal is recorded. This provides a +20 dBm reference level at the spectrum analyzer.

The DUT is then tuned to a frequency of F. The output power is adjusted, if necessary, to +20 dBm. The spectrum analyzer is still tuned to a center frequency of 2F and is therefore measuring the second harmonic of the DUT. The relative harmonic level is calculated by subtracting the +20 dBm reference level from the amplitude level of the second harmonic.

This routine is repeated until the list of test frequencies is exhausted. Third harmonics are tested in the same way, but the +20 dBm reference is established with the DUT set to a CW frequency of 3F. (By setting the reference on the spectrum analyzer at the frequency at which you expect to measure the harmonic, you avoid the spectrum analyzer frequency response error.)

Non-Harmonics

This specification is separated into two main categories: mixer spurs and other spurious signals.

Mixer Spurs. Mixer spurs are generated by the heterodyne process in the A3 source module. Because these spurs are generated in part by the cavity oscillator which resides in the leveling control loop, they are power level dependent. Note they are specified at maximum power level.

These spurs are unwanted products of the mixing process and appear at the sum and difference frequencies of the multiples of the cavity oscillator (F_{cav}) and the YIG Oscillator (F_{yo}). The performance test measures the level of the 2:1 spur and the 3:2 spur. A 2:1 spur is a signal that exists at $2(F_{cav})$ plus or minus F_{yo}. (Spurs at the sums of these two frequencies always occur at frequencies greater than 3 GHz. The DUT specifies the level of in-band impurities only, therefore this routine measures only the difference frequencies.) Likewise, the 3:2 spur is measured at the difference frequency $3(F_{cav})$ minus $2(F_{yo})$.

To accurately calculate the frequency at which these spurs will appear, the exact cavity oscillator frequency must be known. This frequency, nominally 3.8 GHz, is determined by setting the DUT output to a specific CW frequency, and then locating the 2:1 spur. Once the spur frequency is known, the actual cavity oscillator frequency can be algebraically calculated:

$$F_{cav} = (F_{yo} + F_{spur})/2.$$

Spur levels are measured with the same technique described for harmonics. A +20 dBm reference is set on the spectrum analyzer with the DUT set to the calculated spur frequency. Then the frequency of the DUT is changed to the fundamental frequency, and the level of the spur is measured.

Other Spurious Signals. This category includes all other impurities that may appear in the output spectrum. These signals are not power level dependent because the generating mechanism is not in the leveling loop of the source.

An interesting characteristic of these spurs is that the level is frequency dependent. Most of these spurs are generated in the fractional-N synthesizer loop. This loop is the master VCO signal for the DUT. In simplified terms, the fractional-N VCO sweeps from 30 to 60 MHz (or a subset thereof) to generate each of the sub-bands of the DUT. Harmonic mixing translates the stable low frequency VCO signals via the phase-locked loop to the DUT RF output frequencies.

The frequency translation process multiplies the FM-sidebands in the fractional-N VCO output as well as the fundamental. The amplitude relationship of the sideband to the fundamental is proportional to the modulation index:

$A_{sb} = \frac{1}{2} (\Delta F / F_{mod})$

where A_{sb} is the sideband amplitude, delta F is the peak deviation of the frequency modulation, and F_{mod} is the rate of modulation. As the DUT RF output frequency increases, the harmonic number used in the sampling process increases, and therefore the peak deviation increases. The modulation frequency, however, remains the same. (This is the mechanism that generates the spur; for example, modulation by the 100 kHz fractional-N reference.) Therefore A_{sb} increases.

Since the level of spurious signals generated in the synthesizer maintains a linear relationship with the output frequency, the spectrum is tested in one band only (band 7, harmonic multiple = 9). If the spur level is acceptable in the tested band, the effective spur levels in any other band (caused by the same mechanism) are assumed to be within specification.

The following spur-causing mechanisms are tested.

API SPURS. The fractional-N loop incurs a phase error as a result of its divide-by-N process. For any frequency containing a fractional part (F/100 kHz), the VCO will gain in phase with each 100 kHz reference cycle. This error is predictable and repeatable and can therefore be compensated. This is the task of the analog phase interpolators. These circuits generate a negative current proportional to the fractional number, to siphon current away from the VCO drive signal and correct for the phase error.

The side effect of this technique is low-level modulation of the fractional-N VCO frequency when the API currents turn on and off. The level of the API spur is somewhat dependent on the value of the fraction (fractional part of the output frequency). The fractional numbers used in the API spur test are 857 for high band and 433 for midband. The test measures the API spur and its second, third, and fourth harmonics. A test frequency is generated as follows:

RF output = 9(frac-N carrier frequency + API number) + 1 MHz

spectrum analyzer center frequency = RF output + API number x harmonic

The RF output frequency is obtained by taking an integer fractional-N carrier frequency, such as 45 MHz, adding the fractional API number (857), multipying that sum by 9 to arrive at the band 7 RF output frequency and adding 1 MHz because the fractional-N trails the actual RF output by 1 MHz (first LO). The output frequency in this case would be 406.007713 MHz. The performance test uses the spectrum analyzer to examine the spectrum at multiples of the API number away from the output frequency (see **Test Record** for test frequencies).

100 kHz SPURS. The reference frequency for the fractional-N circuit is 100 kHz. The test looks for 100 kHz and 200 kHz (second harmonic) sidebands at several frequencies in band 7.

IF SPURS. This routine measures 4 kHz and 8 kHz sidebands on the RF output frequency. These spurs occur in low band only and are generated on the A12 reference board. The source of the spur is the 40 MHz crystal reference mixing with the 39.996 MHz VCO. The test is performed at 10 MHz only.

SOURCE CROSSING SPURS. These spurs are caused by intermodulation effects in the limiter circuit, which interfaces the A12 reference board phase lock reference signal to the phase lock detector on the A11 phase lock board.

This spur is generated in low band, where a multiple of the 40 MHz crystal reference and a harmonic of the actual .300 to 16 MHz RF signal combine to produce a spur at the same frequency as the RF output signal.

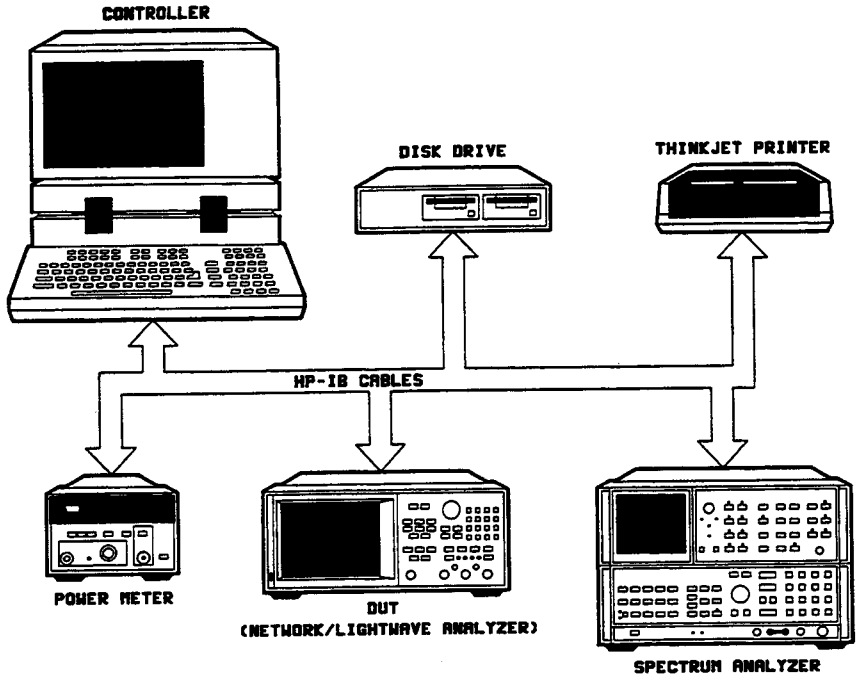


Figure 18. System Configuration for Spectral Purity Tests

EQUIPMENT REQUIRED

Spectrum Analyzer	HP 8566A/B
Power Meter	HP 436A option 022
Power Sensor	HP 8482A
Power Splitter (3-way)	HP 11850C
Power Splitter (2-way)	HP 11667A
Attenuator 20 dB	HP 8491A Option 020
Attenuator 10 dB	HP 8491A option 010
BNC Cable	HP part number 8120-1840
Adapter Type-N (m) to Type-N (m)	HP part number 1250-1475

PROCEDURE

1. Connect equipment as shown in Figure 18.
2. Refer to *GETTING STARTED* at the beginning of this section for instructions on loading the BASIC system and the performance test software. Use *GETTING STARTED* to work your way through the **SYSTEM CONFIGURATION MENU**.
3. From the **PERFORMANCE TEST MENU**, select **Spectral Purity**. The program will perform setup routines such as asking for power sensor calibration factors. Refer to *GETTING STARTED* and follow the instructions for this menu.

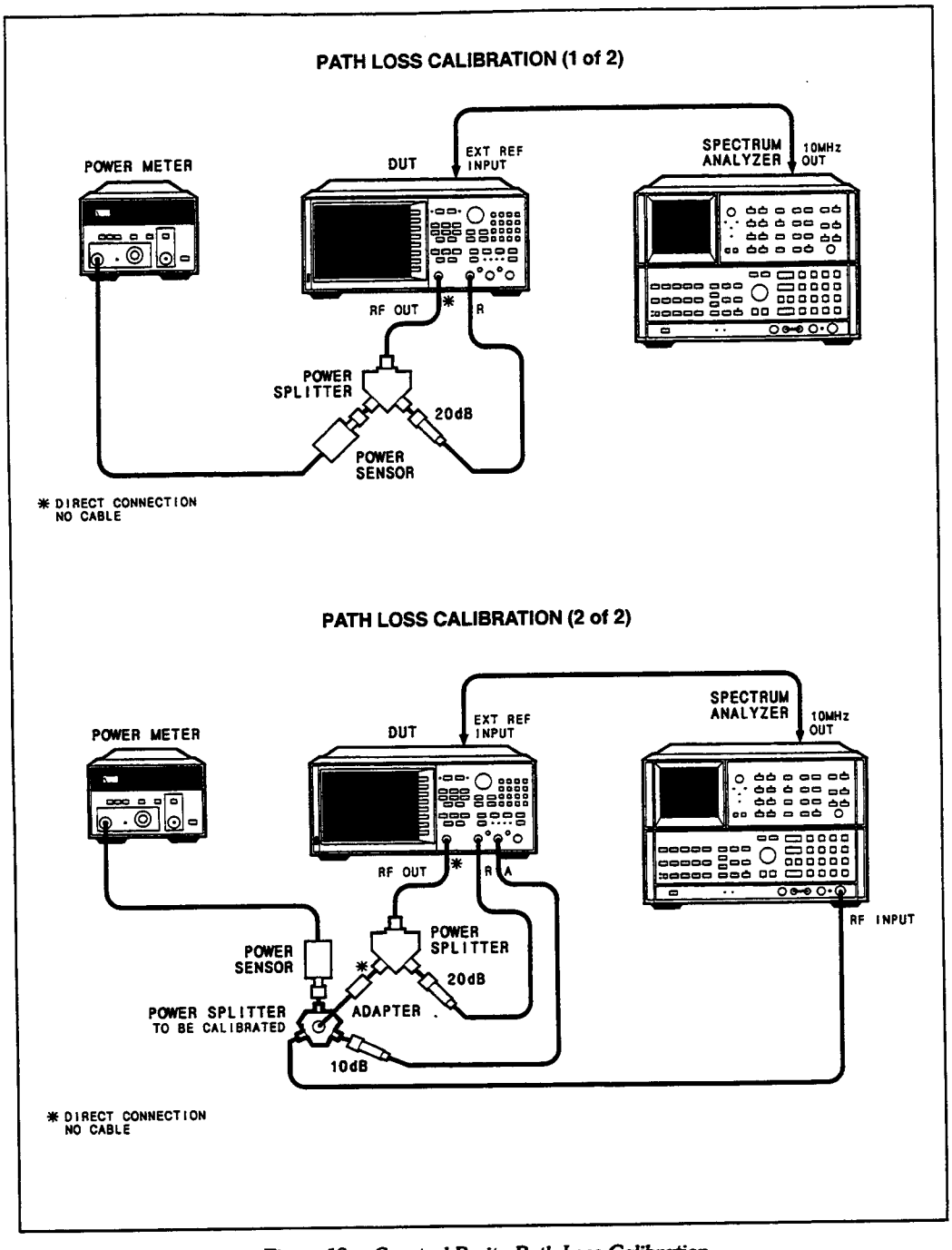


Figure 19. Spectral Purity Path Loss Calibration

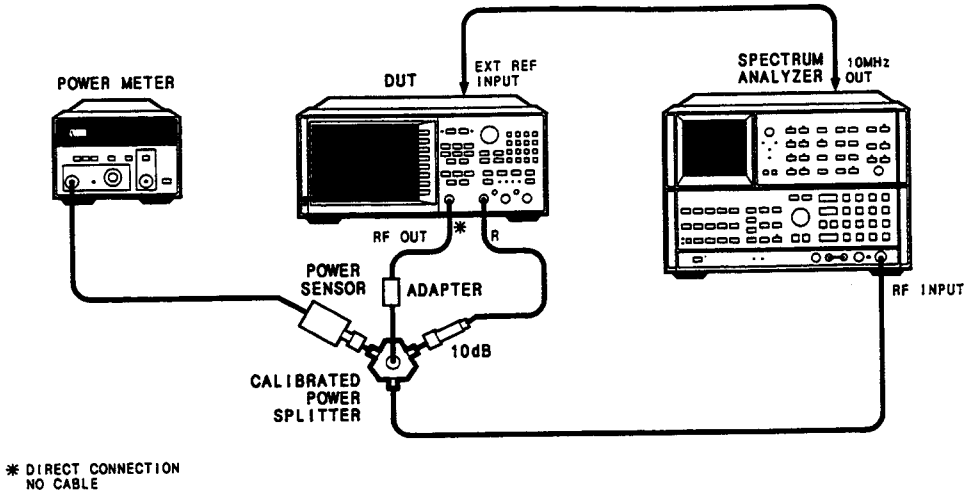


Figure 20. Spectral Purity Test Setup

4. From the **Spectral Purity Tests Menu**, select an individual test or select **ALL TESTS** to run all test routines sequentially without interruption. The first routine selected will invoke the path loss calibration routine. Follow the prompts. They will refer to test setup illustrations contained in this procedure.

5. You can iterate the tests as many times as you like without repeating the path loss calibration, as long as you do not terminate the spectral purity subprogram or change the actual device connections between the DUT and the spectrum analyzer or the power meter.

6. When you are finished with the tests, press **[DONE]** to return to the spectral purity main menu. From here you can select the **RESULTS** menu and print out the test results on the system printer.

IN CASE OF DIFFICULTY

If any test fails, put both the DUT and the spectrum analyzer in local mode and tune each device to the frequency in question. Manually verify that the signals are out of tolerance.

Ensure that any spurious response is not generated by the spectrum analyzer itself. This can be verified by increasing the spectrum analyzer attenuation and observing any change in spur level. If the spur is caused by overdriving the spectrum analyzer input mixer, the effective spur level (dBc below the carrier) will drop with increased attenuation.

Read through the description at the beginning of this test to discover where the out of tolerance signal is being generated. Primarily, harmonics and mixer spurs are a function of the A3 source module. API spurs and 100 kHz spurs are generated in the fractional-N module. If the analyzer fails either part of the test, perform the Fractional-N Spur and FM Sideband adjustment. IF spurs and low band source crossing spurs are generated on the A12 reference board.

Source Crossing Spur Failure

Symptom and Cause

The analyzer fails the source crossing spur part of the spectral purity performance test. This failure can result from the HP 8566A or 8566B spectrum analyzer detecting a large off-screen signal rather than the intended spur. Such failures are attributable to a faulty A16 scan generator assembly in the spectrum analyzer.

Solution #1

Check the spectrum analyzer to see whether it has the assembly in question. If the serial prefix of the spectrum analyzer is greater than the numbers listed below, the spectrum analyzer is probably not contributing to the failure of the source-crossing spur performance test. Repeat the test.

If the serial prefix indicates that the performance of the spectrum analyzer is questionable, check the part number of the A16 assembly. If the A16 assembly part number is listed below, replace that assembly with the recommended one.

Spectrum Analyzer	Questionable Serial Prefix	Faulty A16 Part Number
HP 8566A HP 8566B	2500A and below 2448A and below	85660-60188, 85660-60198 85660-60188, 85660-60198
Recommended replacement A16 assembly:		85660-60247

Solution #2

Review the printed results of the source crossing spur performance test. If any spur is noted as OUT OF LIMITS, set the analyzer to the corresponding "Source Output Frequency (MHz)". Set the spectrum analyzer to the corresponding "Spur Frequency (MHz)". Observe the spur and confirm that it is less than the "MAXIMUM VALUE" indicated.

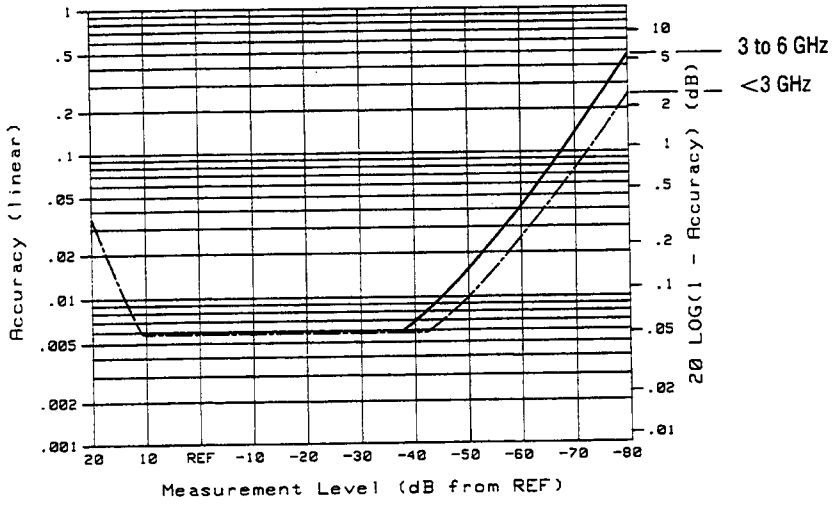
Dynamic Accuracy

SPECIFICATION

Dynamic Range

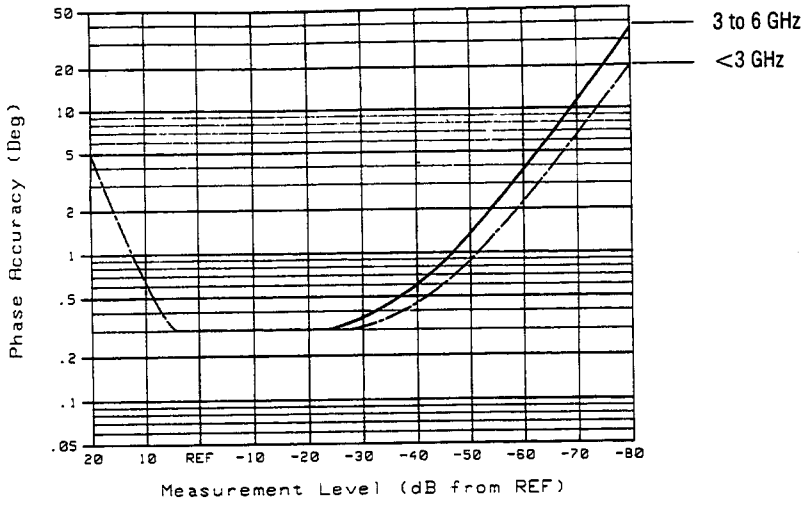
Inputs A, B	100 dB
Input R	35 dB

Magnitude Dynamic Accuracy (Inputs A, B, (R to −35 dBm); 10 Hz bandwidth):



Assumption: Reference Power Level = −20 dBm

Phase Dynamic Accuracy (A/R, B/R, A/B (R to −35 dBm); 10 Hz bandwidth):



Assumption: Reference Power Level = −20 dBm

DESCRIPTION

Dynamic accuracy is a measure of how well the receiver measures the magnitude and phase components of a signal as that signal varies in amplitude over the specified dynamic range. In this case, the power is varied from −10 to −100 dBm by inserting known attenuation values in the receiver path.

Because dynamic accuracy is a function of the 4 kHz IF processing, magnitude dynamic accuracy measurements are made at a single CW frequency of 30 MHz. Phase dynamic accuracy measurements are made at 3 MHz, where there is less phase error contribution by the individual attenuator segments.

Signal compression and expansion in the RF input samplers impact the dynamic accuracy performance of the receiver at higher power levels. The magnitude of this effect is frequency dependent, therefore compression is tested on all inputs at frequencies of 50 MHz, 1 GHz, 2 GHz, and 3 GHz. For these tests, the attenuator is removed, and input power is manipulated with the analyzer output power controls and the power meter.

NOTE: This test allows the use of either a manual or programmable HP 8496A/G attenuator. If the HP 8496G programmable version is used, the HP 11713A attenuator/switch driver module is required to actuate the attenuator upon command from the controller.

NOTE: When receiver performance is measured against a known standard (attenuator), the calibration uncertainty of the standard becomes the primary source of error in the measurement. Hewlett-Packard recommends that attenuators used for this test be calibrated to within 0.03 dB for the 10 through 60 dB steps. This calibration can be obtained from Hewlett-Packard's Loveland Division Standard's Laboratory:

Hewlett-Packard
Loveland Division
815 14th Street S.W.
Loveland, Colorado 80537

EQUIPMENT REQUIRED

Power Meter	HP 436A option 022
Power Sensor	HP 8482A
Power Splitter (3-way)	HP 11850C
Power Splitter (2-way)	HP 11667A Option 001
100 dB Step Attenuator	HP 8496A/G
Attenuator Driver (for HP 8496G only)	HP 11713A
Attenuator Drive Cable (for HP 8496G only)	HP part number 8120-2703
Attenuator 30 dB	HP 8491A Option 030
Attenuator 40 dB	HP 8491A Option 040
50 ohm Termination	HP 908A
Cable Set	HP 11851B
Adapter, Type N (f) to Type N (f)	HP part number 1250-1472
Adapter, Type N (m) to Type N (m)	HP part number 1250-1475

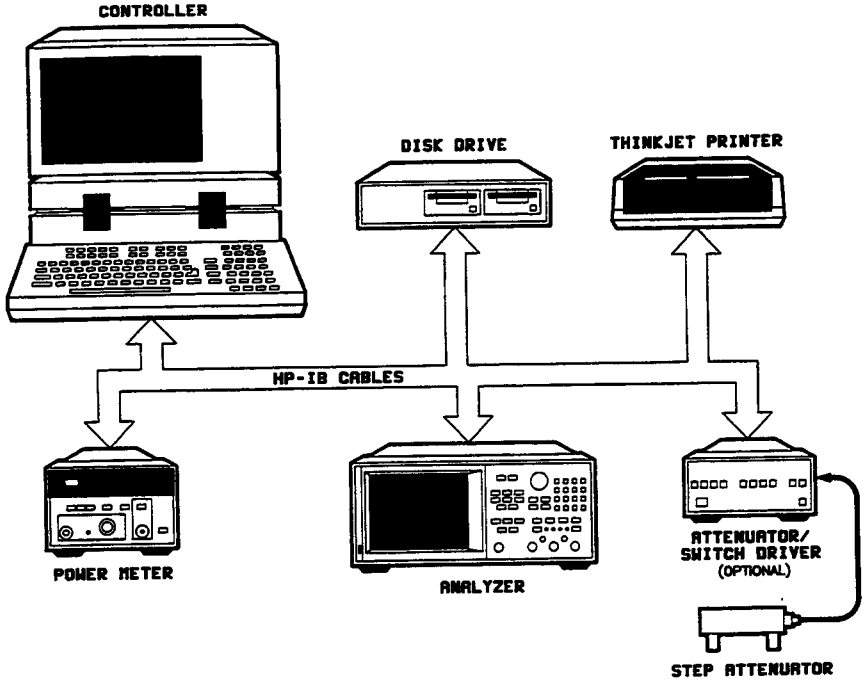


Figure 21. System Configuration for Dynamic Accuracy Tests

PROCEDURE

1. Set up equipment as shown in Figure 21. When using a manual attenuator, HP 8496A, eliminate the HP 11713A attenuator/switch driver. When using a programmable attenuator, HP 8496G, the HP 11713A is required. The program looks for the HP 11713A. If it is not on the HP-IB bus, the program assumes the use of a manual attenuator and will prompt the operator to change the attenuation step at the appropriate time.

2. Refer to *GETTING STARTED* at the beginning of this section for instructions on loading the BASIC system and the performance test software. Use *GETTING STARTED* to work your way through the **SYSTEM CONFIGURATION MENU**.

3. From the **PERFORMANCE TEST MENU**, select **Dynamic Accuracy**. The program will perform setup routines such as asking for power sensor and attenuator calibration factors. Refer to *GETTING STARTED* and follow the instructions for this menu.

4. When you arrive at the **DYNAMIC ACCURACY TESTS** menu, you must select among individual tests. Each test requires a different setup.

   NOTE: The low power measurements made during this test are extremely sensitive to crosstalk. Configure the test setups as shown taking care to separate RF cables to avoid crosstalk paths.

   NOTE: The cables in Figure 24 are numbered 1 through 3 in **INITIAL SETUP**. Cable number 2 is not used in the **MEASUREMENT SETUP**. These cable numbers are intended to clarify which specific cable is to be removed.

   NOTE: The test configurations titled INITIAL SETUP are used to set the power level of the analyzer precisely. This is a low level measurement that requires a long settling time from the power meter (≅10 seconds). Be patient. If the power meter does not settle in the time that routine allows, an error message will be displayed. Press **[REPEAT]** to run that routine again. If the power meter still does not settle, check your test setup.

   You may execute the tests in any order. The order in which they appear in the test menu requires the least number of test setup changes from test to test.

5. Tests may be repeated as many times as you wish.

6. Press **[DONE]** to return to the **Dynamic Accuracy Main Menu**. Select **RESULTS** to output the test data. This test provides output in tabular format (test record) and also provides data plots for each input, similar to the plots used in the specification (see *Specification* above).

IN CASE OF DIFFICULTY

Noise and crosstalk can severely impact the measurement of very small signals. Always repeat a failed test, paying careful attention to the test setup connections and the lay of the cables. Verify that attenuator values are input correctly and that the attenuator calibration is current.

If an input fails in the compression region (−10 to 0 dBm input), suspect the associated input sampler. Verify that the power meter and power sensor are working properly.

Failures at lower power levels are usually due to the A10 digital IF board. Dynamic accuracy error is largely due to non-linearities in the analog-to-digital converter (ADC) and preceding gain stages. The A, B, and R input signals follow individual IF paths (gain stages). However, all inputs are digitized by a multiplexing ADC. Non-linearities in the ADC impact all inputs, whereas non-linearities in the gain stages impact the associated input only. Refer to the *Adjustments* section and perform the *ADC Linearity Correction Constant* routine and the *IF Amplifier Correction Constants* routine.

HP 8496G Causes Dynamic Accuracy Failure

Symptom and Cause

The analyzer fails the dynamic accuracy performance test when an HP 8496G programmable attenuator is used. The programmable attenuator has four attenuation sections, two of them 40 dB sections. This can lead to measurement ambiguities at attention settings that use just one of the 40 dB attenuators. The following table summarizes which attenuation values use which attenuator sections in the dynamic accuracy performance test.

Attenuation	Section Used			
	1	2	3	4
	10	20	40	40
10	x			
20		x		
30	x	x		
40				x
50	x			x
60		x		x
70	x	x		x
80			x	x
90	x		x	x
100		x	x	x

Solution

Send the HP 8496G attenuator to the Standards Laboratory of the HP Loveland Division to be calibrated. The calibration will match the requiements of the performance test sorftware. The address is given in *Description*.

NOTE: The HP 8496A manual attenuator is not affected.

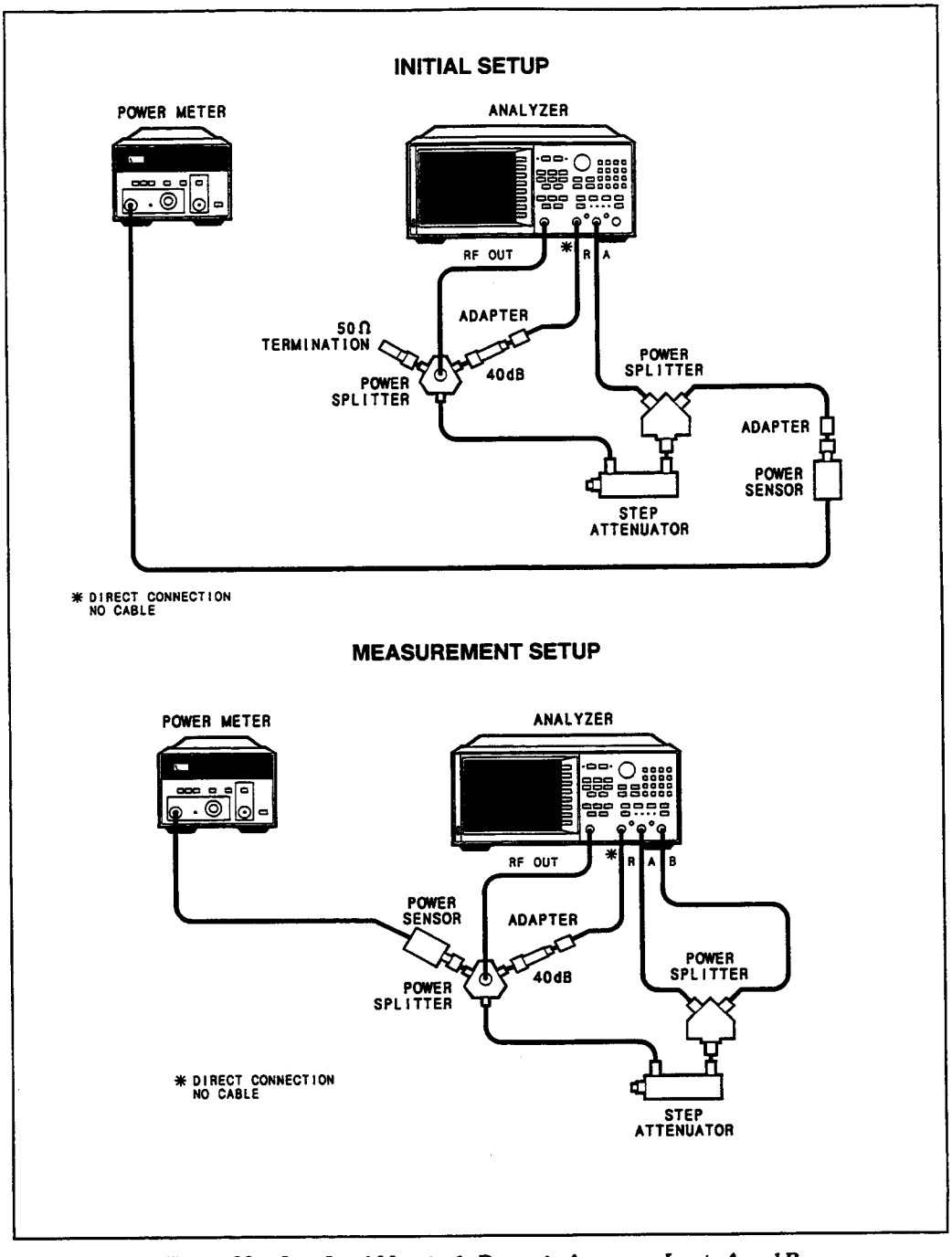


Figure 22. Low Level Magnitude Dynamic Accuracy; Inputs A and B

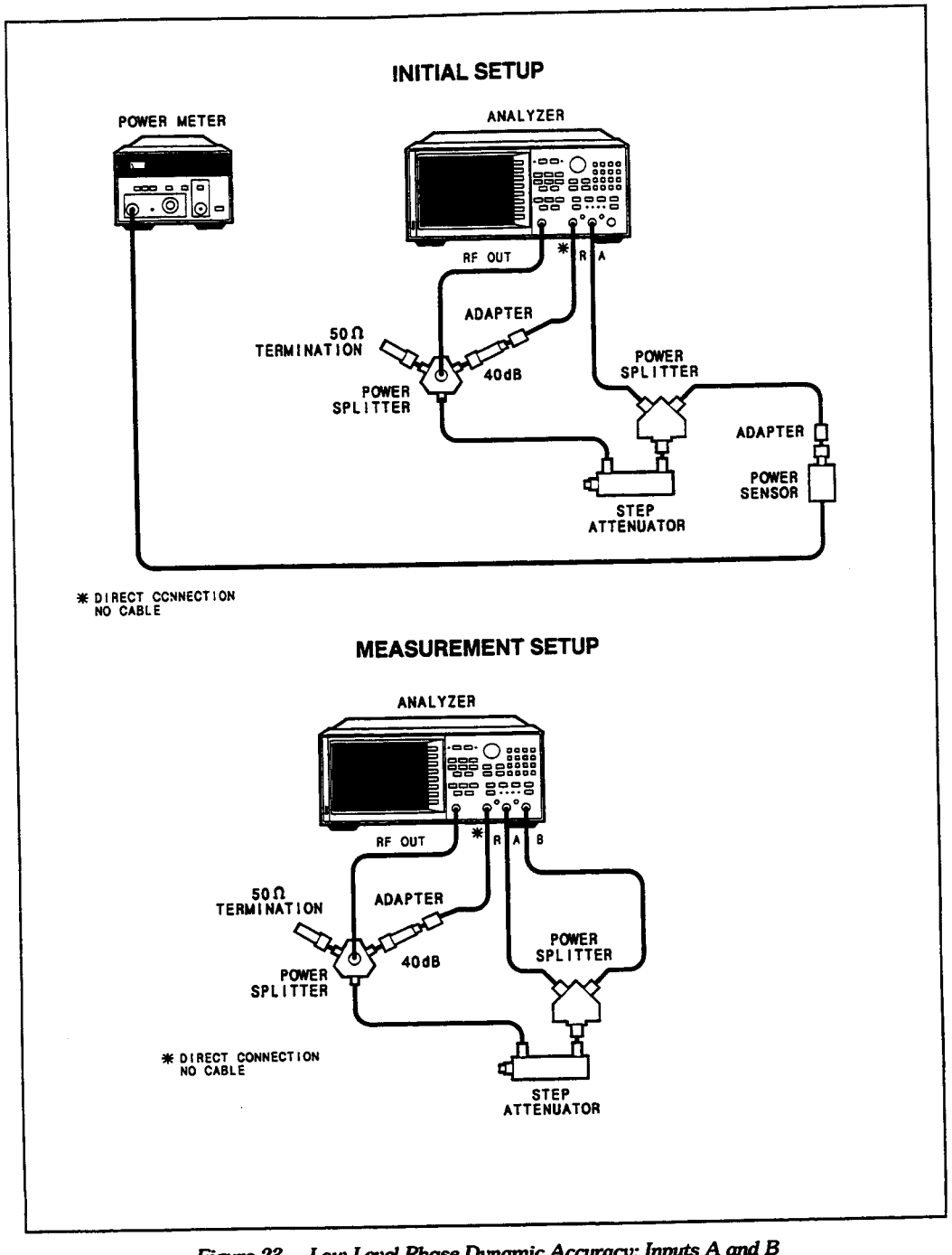


Figure 23. Low Level Phase Dynamic Accuracy; Inputs A and B

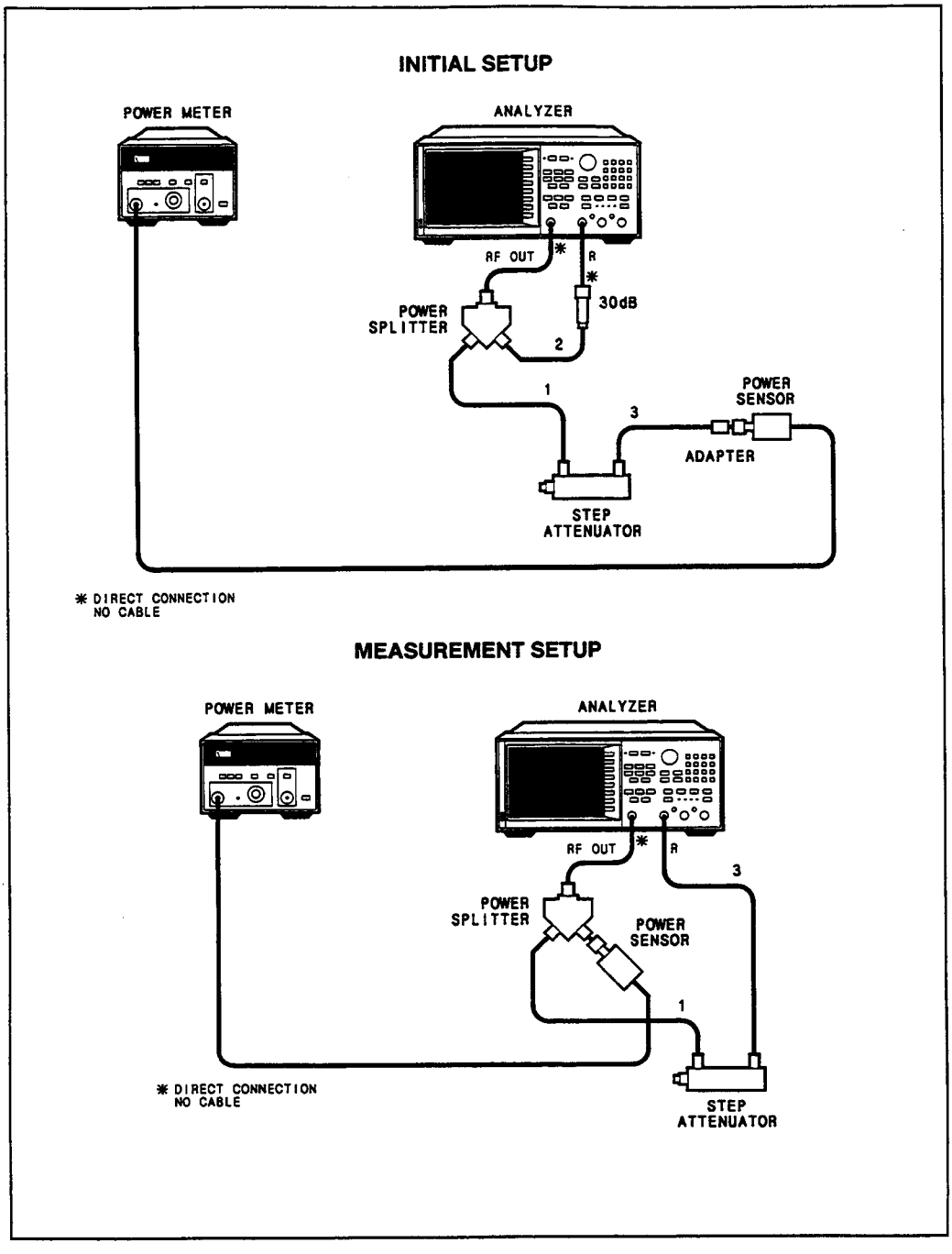


Figure 24. Low Level Magnitude Dynamic Accuracy; Input R

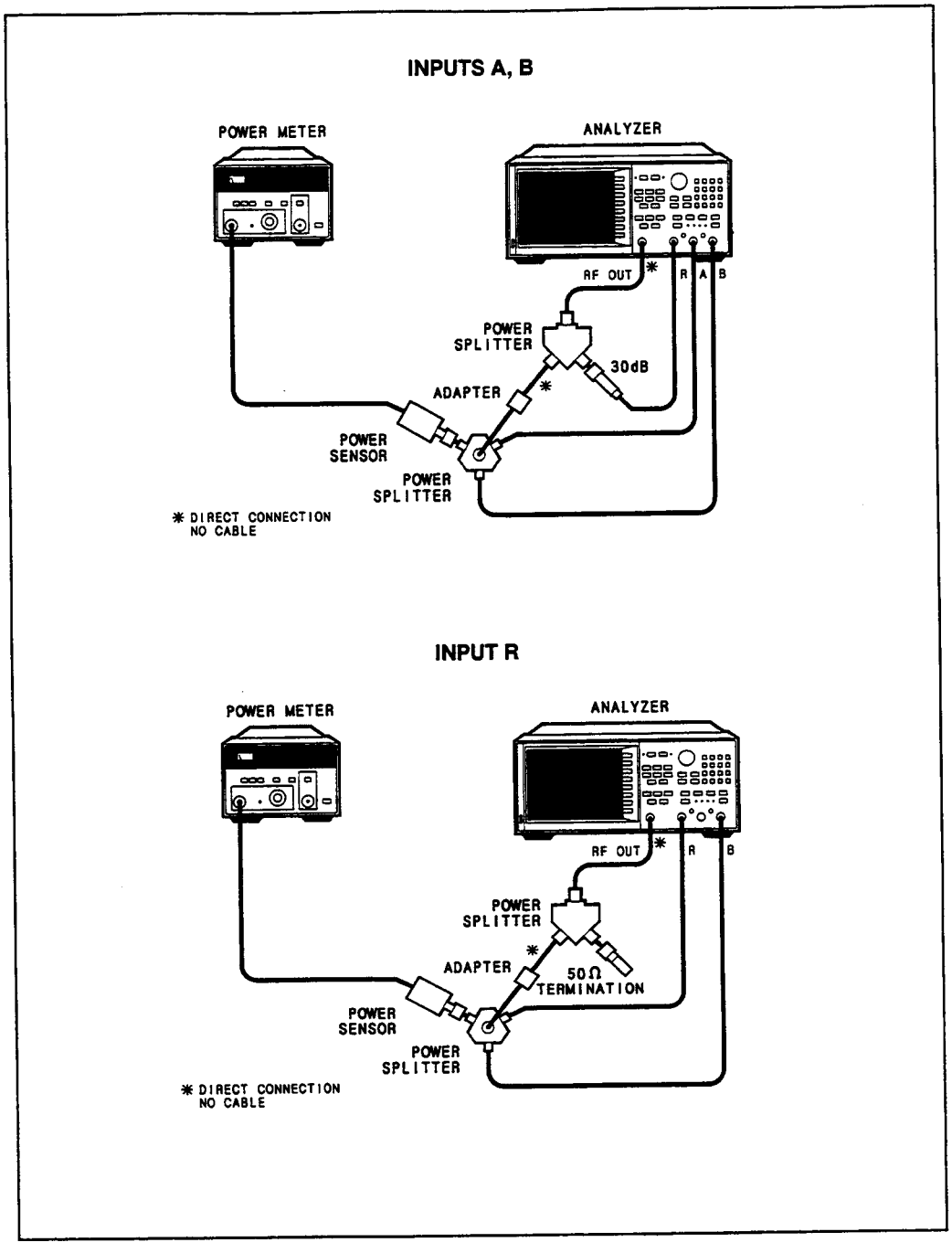


Figure 25. High Level Dynamic Accuracy

Supplemental Performance Tests For HP 8753B/C Only

HP 8753B/C Minimum R Level for External Source Performance Test

SPECIFICATIONS

Minimum R Level for phase lock: −35 dBm

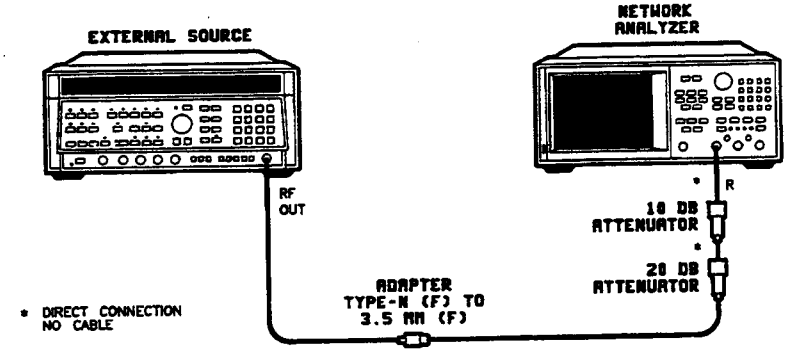


Figure 26. Minimum R Level External Source Test Setup

EQUIPMENT

10 dB attenutor	HP 8491A option 010
20 dB attenuator	HP 8491A option 020
External Source (Harmonics −30 dBc; Flatness 1.1 dB)	HP 8341B
RF cable	part of HP 11851B cable set
Adapter 3.5 mm (f) to type-N (f)	HP part number 1250-1745

DESCRIPTION AND PROCEDURE

This test checks for proper phase lock in external source mode at the specified minimum R input level of −35 dBm. The analog bus counter is used to measure the frequency of the fractional-N VCO while a CW signal is provided to input R from the external source. This value is then compared to the allowable range of fractional-N VCO frequencies for that CW frequency to ensure that the VCO is still phase-locked.

Warm-up time: one hour

1. Connect the equipment as shown in Figure 26.

2. On the external source, press **[PRESET] [POWER LEVEL] [-6] [dBm] [CW] [10] [MHz]** to set the power level and frequency.

3. Press **[PRESET] [SYSTEM]** ***[INSTRUMENT MODE] [EXT SOURCE AUTO]*** to set up the analyzer for an external source input to R.

4. On the network analyzer, press **[SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MEAS]*[S-PARAMETERS] [ANALOG IN]*** **[29] [x1]** ***[COUNTER: FRAC N]*** **[MEAS]** ***[R]*** to set up the analog bus counter to measure the frequency of the fractional-N VCO.

5. Press **[MKR FCTN]** ***[MARKER SEARCH] [TRACKING ON] [SEARCH: MAX]*** to observe the maximum value of the R input signal.

6. The marker value readout in the upper right-hand corner of the display should be −36 dBm. If the power level exceeds −36 dBm, press **[POWER LEVEL]** on the external source and decrease the power until the analyzer reads less than −36 dBm. Press **[MKR FCTN]** ***[MARKER SEARCH] [SEARCH: OFF]*** to turn off the marker search.

7. Record the analog bus counter reading (following "cnt:" on the right side of the display) on the *Performance Test Record*. If this value is within the limits shown on the *Performance Test Record*, the source is properly phase-locked.

8. On the external source, press **[CW] [20] [MHZ]** to change the CW frequency to 20 MHz. On the analyzer, press **[MENU]** ***[CW FREQ]*** **[20] [M/u]**. If the analyzer's marker value readout exceeds −36 dBm, reduce the power level on the external source. Record the analog bus counter reading and compare it with the acceptable limits on the *Performance Test Record.*

9. Repeat step 8 for 100 MHz, 1 GHz, and 3 GHz.

IF THE INSTRUMENT FAILS THIS TEST

Check the flexible RF cable, W8, between the R sampler assembly and the A11 phase lock assembly. Most of the cable should rest on top of the sampler assemblies, not next to the A11 phase lock assembly.

Check the R sampler by substituting the A sampler. Move cable W8 to the A sampler, and use only 10 dB of attenuation between RF OUT and input A. Repeat the test, but press **[MEAS]** ***[A]*** in step 3. If the performance test still fails, suspect the A11 assembly.

HP 8753B/C Option 002 Absolute Amplitude Accuracy Performance Test

SPECIFICATIONS

Absolute Amplitude Accuracy: 16 MHz to 3 GHz ±1 dB

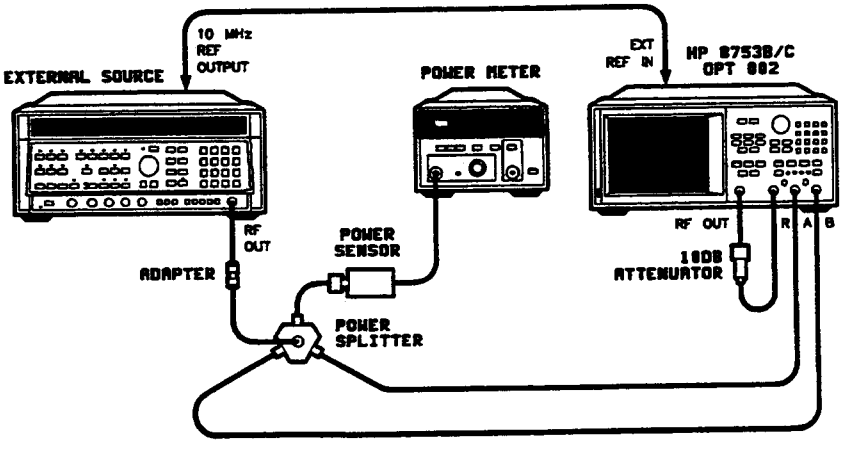


Figure 27. HP 8753B/C Option 002 Absolute Amplitude Accuracy Test Setup

EQUIPMENT

External Source	HP 8341B
Power Meter	HP 436A or 438A
Power Sensor	HP 8482A
Power Splitter 50 Ohm 3-Way	HP 11850C
Adapter Type-N (m) to Type-N (m)	HP Part Number 1250-1475
RF Cable Set	HP 11851B
Attenuator 10 dB	HP 8491A Option 010
BNC Cable	8120-1840

DESCRIPTION AND PROCEDURE

This test is a measure of the receiver's ability to transfer information from RF to IF and to accurately process and display that information. The CW fundamental is applied to the R input from the analyzer's internal source. The external source supplies the second and third harmonics to be measured. These are compared to the power meter reading.

Set the power meter cal factor whenever necessary to compensate for power sensor frequency response variations. Set the power meter mode to measure dBm and zero the meter. For each set (inputs A and B) of harmonic power measurements on the analyzer, also record the power meter reading on the *Supplemental Performance Test Record*. Then calculate the difference between the power meter level and the input A (and B) level and compare results to the specification.

1. Connect the equipment as shown in Figure 27 and allow one hour warm-up.

2. On the external source, press **[PRESET] [POWER LEVEL] [0] [DBM]**. Press **[CW [3] [2] [MHZ]** to set the CW frequency. Record the power meter reading. It should read approximately −10 dBm.

3. On the analyzer, press **[PRESET] [MENU]** ***[CW FREQ]*** **[1] [6] [M/4] [SYSTEM]** ***[HARMONIC MEAS] [SECOND]*** to set up the analyzer to measure the second harmonic (supplied by the external source).

   Press **[MKR] [MEAS]** ***[A]*** and record the marker power level (upper right-hand corner of the CRT) for the second harmonic at input A.

4. Press ***[B]*** and record the second harmonic at input B.

5. Set the external source to the third harmonic. Press **[4] [8] [MHZ]**. Record the power meter level.

6. On the analyzer, press **[SYSTEM]** ***[HARMONIC MEAS] [THIRD]***. Record the third harmonic on input B.

7. Press **[MEAS]** ***[A]*** on the analyzer and record the third harmonic on input A.

8. On the analyzer, press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]***. Set the analyzer to the next fundamental frequency on the *Supplemental Performance Test Record*: press **[MENU]** ***[CW FREQ]*** **[3] [1] [M/4]**.

9. Set the external source to the second harmonic of the fundamental. Press **[6] [2] [MHZ]**. Record the power meter level.

10. On the analyzer, press **[SYSTEM]** ***[HARMONIC MEAS] [SECOND]*** and record the second harmonic on input A. Press **[MEAS]** ***[B]*** and record the second harmonic at input B.

11. Set the external source to the third harmonic of the fundamental. Press **[9] [3] [MHZ]**. Record the power meter level.

12. On the analyzer, press **[SYSTEM]** ***[HARMONIC MEAS] [THIRD]*** and record the third harmonic at input B. Press **[MEAS]** ***[A]*** and record the third harmonic at input A.

13. Repeat steps 8 through 12 for the remaining CW frequencies on the *Supplemental Performance Test Record* and the corresponding second and third harmonics.

14. For each measurement, calculate the difference between the measurement and the power meter level. Compare the results to the specification.

HP 8753B/C Option 002 and 006 Absolute Amplitude Accuracy Performance Test

SPECIFICATIONS

Absolute Amplitude Accuracy: 3 GHz to 6 GHZ +3 dB

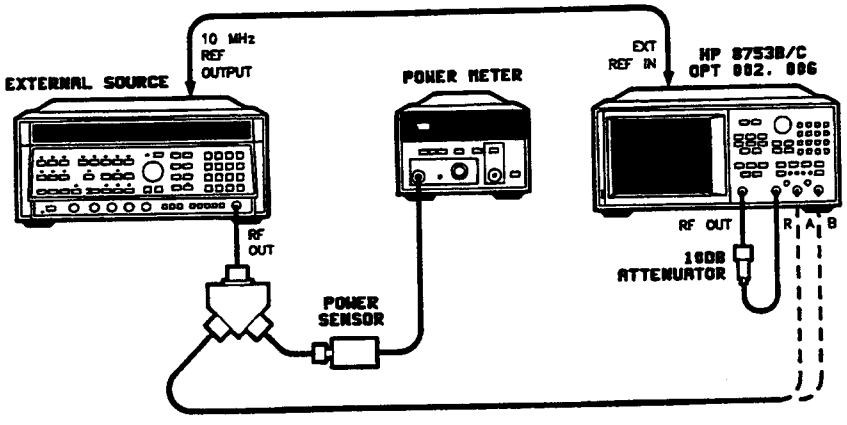


Figure 28. HP 8753B/C Option 002 and Option 006 Absolute Amplitude Accuracy Test Setup

EQUIPMENT

External Source	HP 8341B
Power Meter	HP 436A or 438A
Power Sensor	HP 8481A
Power Splitter	HP 11667A Option 001
Attenuator 10 dB	HP 8491A Option 010
RF Cable Set	HP 11851B
BNC Cable	8120-1840

DESCRIPTION AND PROCEDURE

This test is a measure of the receiver's ability to transfer information from RF to IF and to accurately process and display that information. The CW fundamental is applied to the R input from the analyzer's internal source. The external source supplies the second and third harmonics to be measured. These are compared to the power meter reading.

Set the power meter cal factor whenever necessary to compensate for power sensor frequency response variations. Set the power meter mode to measure dBm and zero the meter. For each harmonic power measurement on the analyzer, also record the power meter reading on the *Supplemental Performance Test Record*. Then calculate the difference between the power meter level and the measurement level and compare results to the specification.

1. Connect the equipment as shown in Figure 28 and allow one hour warm-up.

2. On the external source press **[PRESET] [POWER LEVEL] [-] [4] [DBM] [CW] [4] [GHZ]** to set the power and CW frequency. Record the power meter level.

3. On the analyzer, press **[PRESET] [MENU]** ***[CW FREQ]*** **[2] [G/n] [SYSTEM]** ***[HARMONIC MEAS] [SECOND]*** to set up the analyzer to measure the second harmonic (supplied by the external source).

   Press **[MKR] [MEAS]** ***[A]*** and record the marker power level (upper right-hand corner of the CRT) at input A (4 GHz).

4. Disconnect the cable to input A and connect it to input B. Press **[B]** on the analyzer. Record the new power meter level. Record the marker power level at input B (4 GHz).

5. On the external source, press **[6] [GHZ]** to change the CW frequency. Record the power meter level.

   On the analyzer, press **[SYSTEM]** ***[HARMONIC MEAS] [THIRD]*** and record the marker level for the third harmonic at input B (6 GHz).

6. Disconnect the cable to input B and reconnect it to input A. On the analyzer, press **[MEAS]** ***[A]***. Record the new power meter level and the third harmonic at input A (6 GHz).

7. On the analyzer, press **[SYSTEM]** ***[HARMONIC MEAS] [SECOND]*** **[MENU]** ***[CW FREQ]*** **[3] [G/n]** and record the power meter level and the second harmonic at input A (6 GHz).

8. Disconnect the cable to input A and reconnect it to input B. Press **[MEAS]** ***[B]*** and record the power meter level and the second harmonic at input B (6 GHz).

9. For each measurement, calculate the difference between the measurement and the power meter level and compare the result to the specification.

HP 8753B/C Option 002 Source and Receiver Harmonics Performance Test

SPECIFICATIONS

Source:	2nd Harmonic −25 dBc
	3rd Harmonic −25 dBc
Source and Receiver:	2nd Harmonic −15 dBc
	3rd Harmonic −30 dBc
Receiver:	2nd Harmonic −15 dBc
	3rd Harmonic −30 dBc

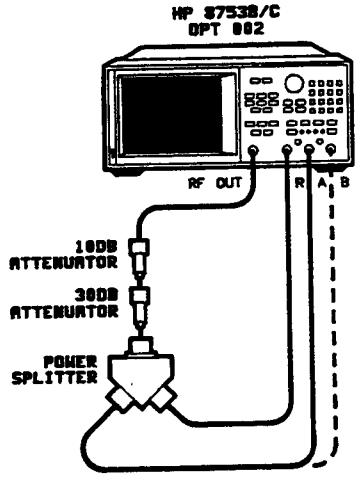


Figure 29. Source Harmonics Test Setup

EQUIPMENT

Power Splitter	HP 11667A Option 001
Attenuator 30 dB	HP 8491A Option 030
Attenuator 10 dB	HP 8491A Option 010
RF Cable Set	HP 11851B

DESCRIPTION AND PROCEDURE

The harmonics tests use the marker search function to measure the worst case 2nd and 3rd harmonics of the source, source and receiver combination, and receiver. Compare the measured results to the specifications.

Source Harmonics

1. Connect equipment as shown in Figure 29. Allow one hour warm-up. Set the analyzer operating parameters.

   Press **[PRESET] [MENU]** ***[POWER]*** **[2] [0] [X1]** to set the power level to +20 dBm.

   Press **[START] [1] [6] [M/4]**. On the analyzer, press **[STOP] [1] [.] [5] [G/n]** to set the frequency range.

   Set the IF bandwidth. Press **[AVG]** ***[IF BW]*** **[1] [0] [X1]**.

2. Press **[MEAS]** ***[A]***. After one sweep press **[DISPLAY]** ***[DATA▸MEMORY] [DATA/MEM]***. This will normalize the trace and record the fundamental.

3. Press **[SYSTEM]** ***[HARMONIC MEAS] [SECOND]***. After one sweep, press **[MKR FCTN]** ***[MKR SEARCH] [MAX]***. Record the marker 1 power level on the *Supplemental Performance Test Record* as the worst case source 2nd harmonic.

4. Change the stop frequency to measure the 3rd harmonic. On the analyzer, press **[STOP] [1] [G/n]**.

5. Find the worst case 3rd harmonic. Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]*** **[DISPLAY]**. After one sweep, press ***[DATA▸***MEMORY] to normalize the trace and record the fundamental. Press **[SYSTEM]** ***[HARMONIC MEAS] [THIRD]***. After one sweep, press **[MKR FCTN]** ***[MKR SEARCH] [MAX]***. Record the marker value on the *Supplemental Performance Test Record*.

Source and Receiver Harmonics

6. Remove the 10 dB attenuator from the test setup shown in Figure 29 to measure the combination of source and receiver harmonics.

   Press **[MENU]** ***[POWER]*** **[6] [X1] [SYSTEM]** ***[HARMONIC MEAS] [OFF]***. On the analyzer, press **[STOP] [1] [.] [5] [G/n]**.

7. Repeat steps 2 and 3 to measure source and receiver 2nd harmonic for input A.

8. Repeat steps 4 and 5 to measure source and receiver 3rd harmonic for input A.

9. Move the A input cable to input B.

   Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]*** to turn off harmonic mode.

   Set the stop frequency. On the analyzer, press **[STOP] [1] [.] [5] [G/n]**.

10. Repeat steps 2 and 3, using input B, to measure source and receiver 2nd harmonic for input B.

11. Repeat steps 4 and 5, using input B, to measure source and receiver 3rd harmonic for input B.

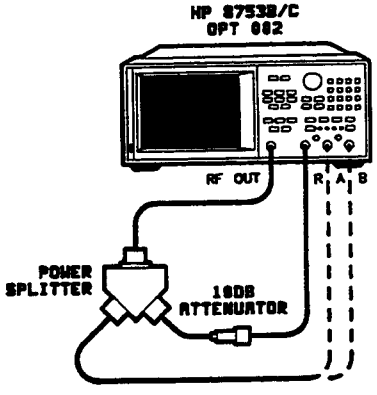


Figure 30. Receiver Harmonics Test Setup

12. Connect the equipment as shown in Figure 30, with the cable connection to input B.

    Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]***. On the analyzer, press **[STOP] [1] [.] [5] [G/n]**.

13. Repeat steps 2 and 3, using input B, to measure receiver 2nd harmonic for input B.

14. Repeat steps 4 and 5, using input B, to measure receiver 3rd harmonic for input B.

15. Press **[SYSTEM]** ***[HARMONIC MEAS] [OFF]***, then repeat steps 2 and 3, using input A, to measure receiver 2nd harmonic for input A.

16. Repeat steps 4 and 5, using input A, to measure receiver 3nd harmonic for input A.

Analyzers with Option 006

To test the high frequency range of all analyzers with option 006, repeat steps 1 through 16 with the following changes:

- Set the analyzer stop frequency to 3 GHz, instead of 1.5 GHz, to measure 2nd harmonics.
- Set the analyzer stop frequency to 2 GHz, instead of 1 GHz, to measure 3rd harmonics.
- Record all results on the Supplemental Performance Test Record under Source and Receiver Harmonics for *Instruments with Option 006.*

IN CASE OF FAILURE

If source harmonics fail, replace the A3 source assembly.

If the A receiver fails, replace the A5 sampler.

If the B receiver fails, replace the A6 sampler.

HP 8753 & 8702 Option 006 Minimum R Level Performance Test

SPECIFICATIONS

Minimum R Level for phase lock: −25 dBm

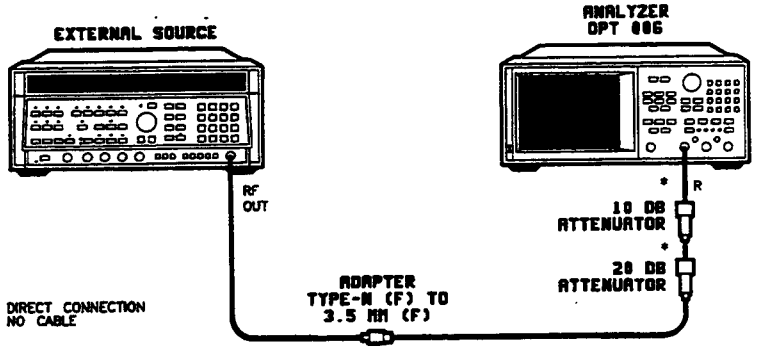


Figure 31. HP 8753B/C, HP 8702B Option 006 Minimum R Level Test Setup

EQUIPMENT

10 dB attenuator	HP 8491A option 010
20 dB attenuator	HP 8491A option 020
External source (Harmonics < −30 dBc; flatness 1.1 dB)	HP 8341B
RF cable	part of HP 11851B cable set
Adapter 3.5 mm (f) to type-N (f)	HP part number 1250-1745

DESCRIPTION AND PROCEDURE

This test checks for proper phase lock from 3 to 6 GHz at the specified minimum R input level of −25 dBm. The analog bus counter is used to measure the frequency of the fractional-N VCO while a CW signal is provided to input R from an external source. This value is then compared to the allowable range of fractional-N VCO frequencies for that CW frequency to ensure that the VCO is phase-locked.

Warm-up time: one hour

1. Connect the equipment as shown in Figure 31.

2. On the external source, press **[PRESET] [POWER LEVEL] [4] [dBm] [CW] [4] [GHz]** to set the power level and frequency.

3. Set up the analyzer for an external source.

   On the HP 8753: Press **[PRESET] [MENU]** ***[CW FREQ]*** **[4] [G/n] [SYSTEM]** ***[INSTRUMENT MODE] [EXT SOURCE AUTO].***

   On the HP 8702: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]*** **[SYSTEM]** ***[SERVICE MENU] [TESTS] [TEST MODE MENU] [INSTRUMENT MENU] [EXT SOURCE AUTO]*** **[MENU]** ***[CW FREQ]*** **[4] [G/n].**

4. Set up the analog bus on the analyzer to measure the frequency of the fractional-N VCO: press **[SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MEAS]** ***[S-PARAMETERS] [ANALOG IN]*** **[29] [x1]** ***[COUNTER: FRAC N].***

5. Set up the marker functions to observe the maximum value of the R input signal.

   On the HP 8753: Press **[MEAS]** ***[R].***
   On the HP 8702: Press **[MEAS]** ***[INPUT PORTS] [R].***

   On all analyzers, press **[MKR FCTN]** ***[MKR SEARCH] [TRACKING ON] [SEARCH: MAX].***

6. The marker value readout in the upper right-hand corner of the display should be −26 dBm. If the power level exceeds −26 dBm, press **[POWER LEVEL]** on the external source and decrease the power until the analyzer reads less than −26 dBm. Press **[MKR FCTN]** ***[MKR SEARCH] [SEARCH: OFF]*** to turn off the marker search.

7. Record the analog bus counter reading (following "cnt:" on the right side of the display) on the *Performance Test Record*. If this value is within the limits shown on the *Performance Test Record*, the source is properly phase-locked.

8. On the external source, press **[CW] [5] [GHz]** to change the CW frequency to 5 GHz. On the analyzer, press **[MENU]** ***[CW FREQ]*** **[5] [G/n].** If the marker value readout exceeds −26 dBm, reduce the power level of the external source. Record the analog bus counter reading and compare it with the acceptable limits on the *Performance Test Record.*

9. On the external source, press **[CW] [6] [GHz]** to change the CW frequency to 6 GHz. On the analyzer, press **[MENU]** ***[CW FREQ]*** **[6] [G/n].** If the marker value readout exceeds −26 dBm, reduce the power level of the external source. Record the analog bus counter reading and compare it with the acceptable limits on the *Performance Test Record.*

IF THE INSTRUMENT FAILS THIS TEST

Check the flexible RF cable W8 between the R sampler assembly and the A11 phase lock assembly. Most of it should rest on top of the sampler assemblies, not next to the A11 phase lock assembly.

Check the R sampler by substituting the A sampler. Move cable W8 to the A sampler, and use only 10 dB of attenuation between RF OUT and input A. Repeat the test, but press **[MEAS]** ***[A]*** in step 5. If the performance test still fails, suspect the A11 assembly.

HP 8753B/C, HP 8702B Option 006 Input Crosstalk Performance Test

SPECIFICATIONS

Input Crosstalk (10 Hz IF bandwidth): −85 dBm from 3.5 GHz to 4.5 GHz
−75 dBm from 5.0 GHz to 6.0 GHz

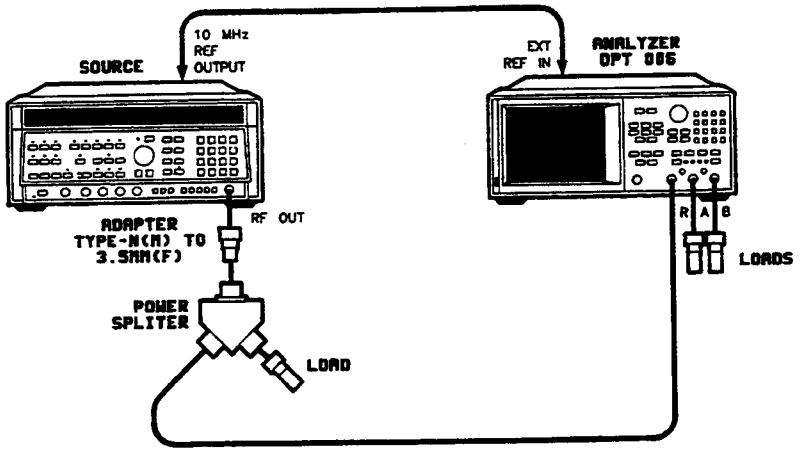


Figure 32. HP 8753B/C, HP 8702B Option 006 R-into-A and R-into-B Input Crosstalk Test Setup

EQUIPMENT

Synthesized sweeper	HP 8341B
50W power splitter	HP 11667A option 001
50W termination (3)	HP 908A
20 dB attenuator	HP 8491A option 020
50W RF cable set	HP 11851B
BNC Cable	8120-1840
Adapter 3.5 mm (f) to type-N (m)	HP part number 1250-1744

DESCRIPTION AND PROCEDURE

This tests the signal leakage interference between inputs when one input is driven and another terminated. As input R is used for phase lock, A-into-R and B-into-R crosstalk is not tested. Ratioed measurements are used to compensate for any frequency response effects.

R-into-A Crosstalk

1. Connect the equipment as shown in Figure 32. On the HP 8341B, press **[POWER LEVEL] [6] [GHz dB(m)]**.

   On the HP 8753B/C: press **[PRESET] [SYSTEM]** ***[INSTRUMENT MODE] [EXT SOURCE AUTO]*** **[AVG]** ***[AVERAGING FACTOR]*** **[5] [x1]** ***[AVERAGING ON] [IF BW]*** **[1] [0] [x1]** to set up the instrument. Disregard any error messages on the CRT.

   Then press **[MKR FCTN]** ***[MKR SEARCH ON] [TRACKING ON] [SEARCH: MAX]***.

   On the HP 8702B: press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]*** **[SYSTEM]** ***[SERVICE MENU. [TESTS] [TEST MODE MENU] [INSTRUMENT MENU] [EXT SOURCE AUTO]*** **[AVG]** ***[AVERAGING FACTOR]*** **[5] [x1]** ***[AVERAGING ON] [IF BW]*** **[1] [0] [x1]** to set up the instrument. Disregard any error messages on the CRT.

   Then press **[MKR FCTN]** ***[MKR SEARCH ON] [TRACKING ON] [SEARCH: MAX]***.

2. On the HP 8341B, press **[CW] [3.5] [GHz dB(m)]**.

   On the analyzer, press **[MENU]** ***[CW FREQ]*** **[3.5] [G/n]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. At the end of the fifth sweep, "Hld" will appear on the CRT. Read the number one marker value (visible in the upper right-hand corner of the CRT, after "1: "). Write this value on the *Supplemental Performance Test Record*.

3. Repeat step 2 for the remaining frequencies listed on the *Record*.

R-into-B Crosstalk

4. On the analyzer, press **[MEAS]** ***[B/R]*** ([**MEAS**] ***[INPUT PORTS] [B/R]*** for 8702) and repeat step 2 for the R-into-B frequencies on the *Record*.

B-into-A Crosstalk

5. Connect the equipment as shown in Figure 33. On the analyzer press **[MEAS]** ***[A/B]***([**MEAS**] ***[INPUT PORTS] [A/B]*** for 8702) and repeat step 2 for the B-into-A frequencies on the *Record*.

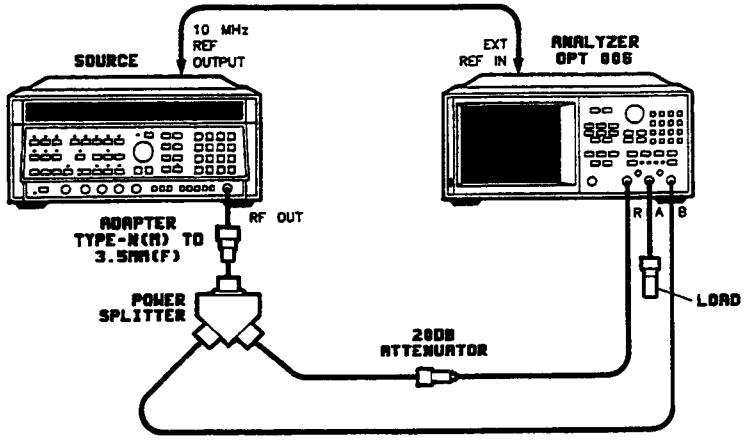


Figure 33. HP 8753B/C, HP 8702B Option 006 B-into-A and A-into-B Input Crosstalk Test Setup

A-into-B Crosstalk

6. Reconfigure the instrument by moving the 50W load from input A to input B and moving the cable from input B to input A.

7. On the HP 8341B, press **[3] [.] [5] [GHz dB(m)]**.

   On the analyzer, press **[MENU]** ***[CW FREQ]*** **[3] [.] [5] [G/n]**. Then press **[MEAS]** ***[A/R]*** (**[MEAS]** ***[INPUT PORTS] [A/R]*** for 8702) **[AVG]** ***[AVERAGING OFF]*** **[MENU]** ***[TRIGGER MENU] [SINGLE]***. At the end of the sweep, press **[DISPLAY]** ***[DATA]*** MEMORY] [DATA/MEM] **[MEAS]** ***[B/R]*** (**[MEAS]** ***[INPUT PORTS] [B/R]*** for 8702) to set up a B/A measurement (by ratioing out the R data).

   Press **[AVG]** ***[AVERAGING ON]*** **[MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** **[5] [x1]**. When the analyzer stops sweeping, record the marker value on the Supplemental Performance Test Record.

8. Repeat step 7 for the other frequencies on the *Record*.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: loose external RF test cable and termination connectors. Inspect all cables for signs of damage, wear, or faulty shielding.

Remove the network analyzer top cover and tighten any loose SMA connector nuts on the four semi-rigid cables located between the A4/5/6 sampler/mixer assemblies and the front panel type-N connectors. These connectors should be torqued to 8 pound-inches.

Tighten any loose screws on the A4/5/6 sampler/mixer assembly covers, and on the A7 pulse generator assembly. Inspect the shielding clips on the A5 sampler/mixer and A7 pulse generator. Inspect the shielding posts on the A10 digital IF board assembly.

Related adjustments: none.

To troubleshoot: see *Receiver*.

HP 8753B/C, HP 8702B Option 006 Frequency Response Performance Test

SPECIFICATIONS

Magnitude Ratio Accuracy (A/R, B/R, A/B): ±2.5 dB
Phase Frequency Response (A/R, B/R, A/B): ±10° from linear phase
(−10 dBm on all inputs)

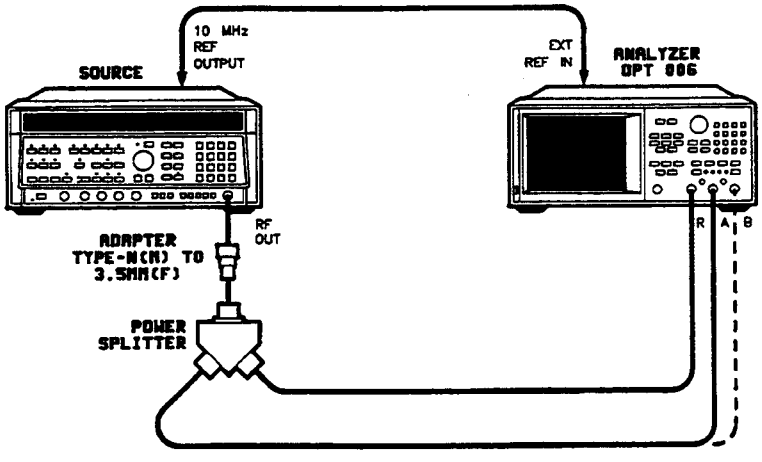


Figure 34. HP 8753B/C, HP 8702B Option 006 Frequency Response Test Setup

EQUIPMENT

Synthesized sweeper	HP 8341B
50W two-way power splitter	HP 11667A option 001
50W RF cable set	HP 11851B
BNC cable	HP part number 8120-1839
Adapter 3.5 mm (f) to type-N (m)	HP part number 1250-1744

DESCRIPTION AND PROCEDURE

This performance parameter is a typical characteristic but not a guaranteed specification; testing it is recommended but not required.

This test determines the magnitude ratio accuracy for each pair of inputs by measuring the peak-to-peak variation of the ratioed trace. It also determines the phase tracking frequency response, measured as deviation from linear phase. Warm-up time: one hour.

Magnitude Ratio Accuracy

1. Connect the equipment as shown in Figure 34, with RF cables to inputs R and A. Turn on the instruments.

   On the external source, press **[PRESET]** ***[POWER LEVEL]*** **[–] [4] [GHz dB(m)]** ***[CW]*** **[3] [GHz dB(m)]** to set the analyzer input power level to about −10 dBm.

   On the HP 8753B/C: press **[PRESET] [SYSTEM]** ***[INSTRUMENT MODE] [TUNED RECEIVER]*** **[AVG]** ***[IF BW]*** **[3] [0] [0] [x1] [MEAS]** ***[A/R] [MENU] [CW FREQ]*** **[3] [G/n]**

   Then press **[MKR]** ***[MKR ZERO]*** to set 3 GHz as the standard.

   On the HP 8702B: press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]*** **[SYSTEM] [SERVICE MENU] [TESTS] [TEST MODE MENU] [INSTRUMENT MENU] [TUNED RECEIVER] [AVG]** ***[IF BW]*** **[3] [0] [0] [x1] [MEAS]** ***[INPUT PORTS] [A/R]*** **[MENU]** ***[CW FREQ]*** **[3] [G/n]**

   Then press **[MKR]** ***[MKR ZERO]*** to set 3 GHz as the standard.

2. On the HP 8341B, press **[3.5] [GHz dB(m)]** to select the first frequency.

   On the analyzer, press **[MENU]** ***[CW FREQ]*** **[3.5] [G/n]** to select the first frequency.

   Enter the marker "1:" value (visible above the graticule on the CRT) in the *Supplemental Performance Test Record*.

3. Repeat step 2 for the remaining A/R frequencies on the *Record*.

4. Move the RF cable from input A to input B of the analyzer. Press **[MEAS] [B/R]** (**[MEAS]** ***[INPUT PORTS] [B/R]*** for 8702). Set both instruments to 3 GHz and press **[MKR]** ***[MKR ZERO DREF = D]*** to reset the standard.

   Perform step 2 for the B/R frequencies on the *Supplemental Performance Test Record*.

5. Move the RF cable from input R to input A of the analyzer (see Figure 35). Press **[MEAS] [A/B]** (**[MEAS]** ***[INPUT PORTS] [A/B]*** for 8702). Set both instruments to 3 GHz and press **[MKR]** ***[MKR ZERO DREF = D]*** to reset the standard.

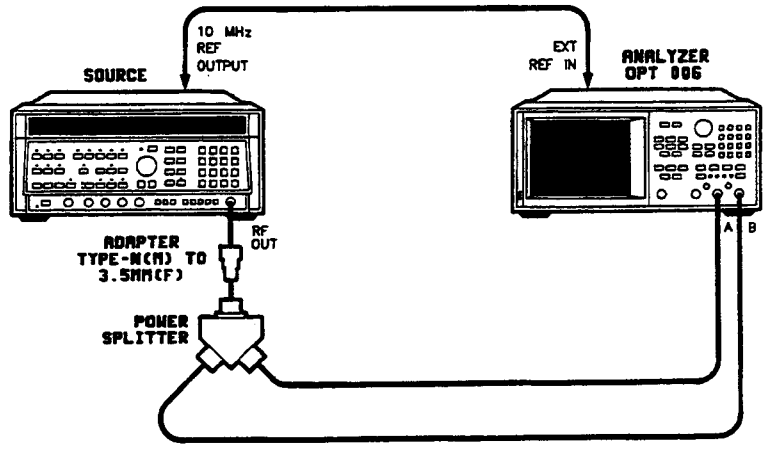


Figure 35. HP 8753B/C, HP 8702B Option 006 Frequency Response Test Setup

Perform step 2 for the A/B frequencies on the *Supplemental Performance Test Record*.

Phase Ratio Accuracy

6. Move the RF cable from input B to input R as shown in Figure 34. On the analyzer press **[MKR]** ***[D MODE MENU]*** ***[D MODE OFF]*** **[MEAS]** ***[A/R]*** (**[MEAS]** ***[INPUT PORTS]*** ***[A/R]*** for 8702) **[FORMAT]** ***[PHASE]*** **[MENU]** ***[CW FREQ]*** **[1] [0] [M/u]**.

   On the HP 8341B, press **[CW] [1] [0] [MHz sec]**.

   Record the analyzer phase value:_____.

7. On the HP 8341B, press **[CW] [6] [GHz dB(m)]**.

   On the analyzer, press **[MENU]** ***[CW FREQ]*** **[6] [G/n] [SCALE REF]** ***[ELECTRICAL DELAY]*** and rotate the RPG knob until the phase value matches the value recorded in step 6. (Step 6 and 7 approximate the most linear horizontal phase position.)

A/R Phase Ratio Accuracy

8. Set the HP 8341B and the analyzer to the CW frequencies listed in the *Supplemental Performance Test Record* and note the A/R phase values there.

B/R Phase Ratio Accuracy

9. Move the RF cable from input A to input B and repeat steps 6 and 7, but now press **[MEAS]** ***[B/R]*** (**[MEAS]** ***[INPUT PORTS]*** ***[B/R]*** for 8702) .

   Record the next phase value (at 10 MHz) here: _____ . Again match it at 6 GHz.

Set the HP 8341B and the analyzer to the CW frequencies listed in the *Supplemental Performance Test Record* and note the B/R phase values there.

A/B Phase Ratio Accuracy

10. Move the RF cable from input R to input A (see Figure 35). Repeat steps 6 and 7, but now press **[MEAS]** ***[A/B]*** (**[MEAS]** ***[INPUT PORTS]*** ***[A/B]*** for 8702) .

    Record the next phase value (at 10 MHz) here: _____ . Again match it at 6 GHz.

    On the HP 8341B and the analyzer, select the frequencies listed in the *Supplemental Performance Test Record* and note the A/B phase values there.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: the power splitter and RF cables if the phase ratio accuracy measurement fails. Move the RF cables to different ports on the power splitter and re-measure the inputs that failed.

Related adjustments: the sampler diode bias adjustment and the sampler magnitude and phase correction constants.

To troubleshoot: see *Receiver*.

HP 8753B/C, HP 8702B Option 006 Compression Performance Test

SPECIFICATIONS

Compression: ≥0.3 dB 3 GHz to 6 GHz

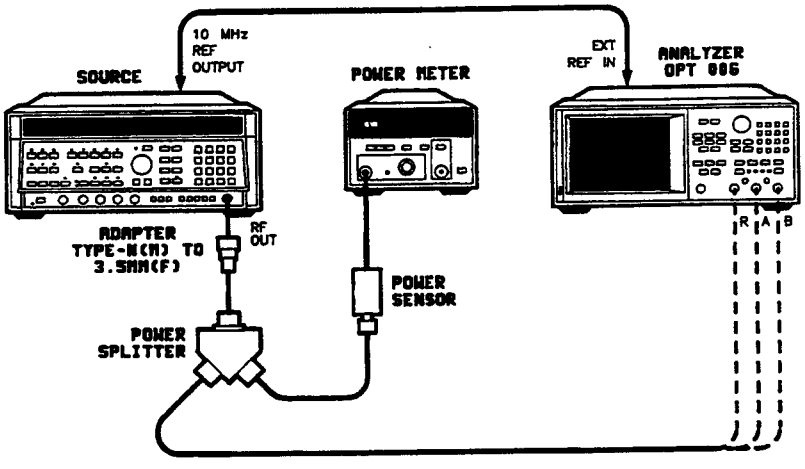


Figure 36. HP 8753B/C, HP 8702B Option 006 Compression Test Setup

EQUIPMENT

Synthesized Sweeper	HP 8341B
Power Splitter 50 Ohm	HP 11667A Option 001
Power Meter	HP 436A/438A
Power Sensor	HP 8481A
Termination 50 Ohm	HP 908A
RF Cable Set	HP 11851B
Adapter 3.5 mm (f) to type-N (m)	HP part number 1250-1744

DESCRIPTION AND PROCEDURE

This test measures the signal compression or expansion in all RF input samplers. Signal compression or expansion affects receiver dynamic accuracy at higher power levels and is frequency dependent.

In this test, set the power meter cal factor whenever necessary to compensate for power sensor frequency response variations. Set the power meter mode to measure dBm and zero the meter.

1. Connect the equipment as shown in Figure 36 and allow one hour warm-up.

2. Preset the source and analyzer.

   On the HP 8753B/C: press **[SYSTEM]** ***[INSTRUMENT MODE]*** ***[TUNED RECEIVER]*** **[AVG]** ***[IF BW]*** **[300] [x1] [MKR]**.

   On the HP 8702B: press **[CAL]** ***[DEVICE TYPE]*** ***[E/E]*** **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** ***[TEST MODE MENU]*** ***[INSTRUMENT MENU]*** ***[TUNED RECEIVER]*** **[AVG]** ***[IF BW]*** **[300] [x1] [MKR]**.

3. Set the frequency. On the analyzer, press **[MENU]** ***[CW FREQ]*** **[4] [G/n]**.

   On the source, press **[CW] [4] [GHZ] [POWER LEVEL] [6] [DBM]**. Adjust the source for a 0 dBm reading (as close as possible) on the power meter. Record this value on the *Supplemental Performance Test Record*.

4. On the analyzer, press **[MEAS]** ***[R]*** (**[MEAS]** ***[INPUT PORTS]*** ***[R]*** for 8702B) and record the marker 1 power level (upper right-hand corner of the CRT) for input R.

5. Disconnect the cable to input R and connect it to input A. On the analyzer, press ***[A]***. Record the power meter reading and the marker 1 power level for input A.

6. Disconnect the cable to input A and connect it to input B. On the analyzer, press ***[B]***. Record the power meter reading and the marker 1 power level for input B.

7. Reset the source power. Press **[–] [9] [DBM]**. Record the power meter reading (approximately −15 dBm) and the marker 1 power level for input B.

8. Disconnect the cable to input B and connect it to input A. On the analyzer, press ***[A]***. Record the power meter reading and the marker 1 power level for input A.

9. Disconnect the cable to input A and connect it to input R. On the analyzer, press ***[R]***. Record the power meter reading and the marker 1 power level for input R.

10. Repeat steps 3 through 9 for each CW frequency listed on the *Supplemental Performance Test Record*.

11. Calculate the compression, for each frequency and input, using the following equation. Enter the answers in the RESULT column.

    Compression =
    (Power meter reading at 0 dBm minus Power meter reading at −15 dBm)
    minus (Marker 1 power level at 0 dBm minus Marker 1 power level at −15 dBm).

IF THE INSTRUMENT FAILS THIS TEST

Noise and crosstalk significantly impact the measurement of very small signals. Check the test set-up connections and cables and repeat the test.

Verify that the power meter and sensor are working properly.

If an input still fails, suspect the associated input sampler.

HP 8753B/C, HP 8702B Option 006 Absolute Amplitude Accuracy Performance Test

SPECIFICATIONS

Absolute Amplitude Accuracy: 3.0 GHz to 6.0 GHz ±3 dB

EQUIPMENT

Same as previous test (HP 8753B/C, HP 8702B option 006 compression performance test).

DESCRIPTION AND PROCEDURE

This test measures receiver performance: how well information is transferred from RF to IF and how accurately that information is processed and displayed. See the *Supplemental Performance Test Record* for specifications. Warm-up time: one hour.

NOTE: In the following steps, set the power meter cal factor whenever necessary to compensate for variations in power sensor frequency response.

1. Zero the power meter and set it to measure dBm. Connect the equipment as shown in Figure 36, with the RF cable at input R. Preset the source and analyzer.

2.

   On the HP 8753B/C: press **[MKR] [SYSTEM]** ***[INSTRUMENT MODE] [TUNED RECEIVER]*** **[MEAS]** ***[R]*** **[MENU]** ***[CW FREQ]***.

   On the HP 8702B: press **[MKR] [SYSTEM]** ***[SERVICE MENU] [TESTS] [TEST MODE MENU] [INSTRUMENT MENU] [TUNED RECEIVER]*** **[MEAS]** ***[INPUT PORTS] [R] [MENU]*** **[CW FREQ]**.

3. Set the source to the first frequency listed in the *Supplemental Performance Test Record*. Set the source power to register 0 dBm on the power meter. On the analyzer press **[3] [.] [5][G/n]**. Record the power meter reading and the analyzer reading on the *Record*.

4. Set the source and the analyzer to each of the remaining frequencies on the *Record* and record each power meter reading as in step 3.

5. Move the RF cable from input R to input A. Press **[MEAS]** ***[A]*** (**[MEAS]** ***[INPUT PORTS] [A]*** for 8702) **[MENU]** ***[CW FREQ]*** and repeat step 2 for input A.

6. Move the RF cable from input A to input B. Press **[MEAS]** ***[B]*** (**[MEAS]** ***[INPUT PORTS] [B]*** for 8702) **[MENU]** ***[CW FREQ]*** and repeat step 2 for input B.

7. For each frequency measured, record the value of the greatest difference: first power meter reading versus R, second power meter reading versus A, or third power meter reading versus B.

IF THE INSTRUMENT FAILS THIS TEST

Suspect: poor tracking between ports of the power splitter if all inputs fail. Suspect source drift if A and B fail at any frequency; repeat the test for that input.

Related adjustments: sampler diode bias adjustment, sampler magnitude and phase correction constants.

To troubleshoot: see *Receiver* and *Source*.

Supplemental Frequency Offset Mode Performance Test

SPECIFICATIONS

Maximum Data Trace Variation: 1 dB p-p

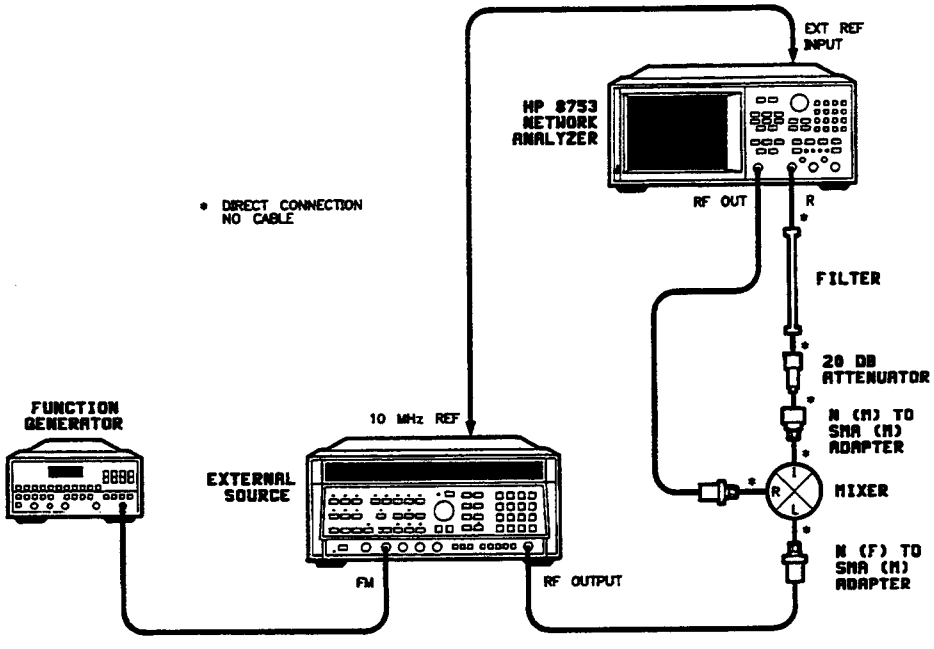


Figure 37. Frequency Offset Mode Test Setup

EQUIPMENT

Mixer	Mini-Circuits ZFM-15
Signal Generator	HP 8341B
Function Generator	HP 8116A, 3312A
Low pass filter	HP 360B
20 dB attenuator	HP 8491A opt 020
Adapter, type-N(m) to SMA(m)	P/N 1250-1636
Adapters (2), type-N(f) to SMA(m)	P/N 1250-1562
Adapter, type-N(f) to BNC(m)	P/N 1250-0077
Type-N cables (2)	HP 11851B
BNC cables (2)	P/N 8120-1838

NOTE: The test is written using the equipment recommended above. Other models may be substituted, including those with different specifications, as long as the frequencies or power levels given in the test procedure are changed appropriately. The following limitations apply:

- All signal generator critical specifications must be met except for frequency range.
- The signal entering the HP 8753's R input must be from 16 MHz to 3 GHz.
- The power level into the R input must be at least −35 dBm

DESCRIPTION AND PROCEDURE

This optional performance test verifies the operation of the HP 8753 in frequency offset mode. Both the RF > LO and RF < LO modes are tested. A noisy LO signal is used to check the analyzer's tolerance to FM on its input. The LO signal is swept over a 2 MHz span to determine if the analyzer can phase lock even when the input frequency is not exactly what's expected. The combination of these factors should result in less than 1 dB peak-to-peak variation in the data trace.

1. Connect a cable from RF OUT to the R input on the HP 8753 and turn it on. Press **[PRESET]** **[MENU]** ***[TRIGGER MENU]*** ***[HOLD]***.

2. Connect the equipment as shown in Figure 37.

3. Set up the function generator to produce a 100 mV peak-to-peak, 10 kHz square wave.

4. Preset the signal generator, then set it up for the following parameters. The keystrokes are given for an HP 8341B synthesized sweeper.

Parameter & Setting	HP 8341B Keystrokes
Center frequency = 2.5 GHz	[CF] [2.5] [GHz]
Span = 2 MHz	[DF] [2] [MHz]
Power = +10 dBm	[POWER LEVEL] [10] [dB(m)]
Sweep time = 11 seconds	[SWEEP TIME] [11] [sec]
FM Sensitivity = 1 MHz/V	(default)
Single sweep	[SINGLE]

5. On the HP 8753, press **[MEAS]** ***[R]*** ***[MENU]*** ***[CW FREQ]*** **[400]** **[M/u]** ***[SWEEP TIME]*** **[10]** **[x1]** **[MKR FCTN]** ***[STATS ON]***.

   For firmware revision 4.02 or below only

   Next, press **[SYSTEM]** ***[INSTRUMENT MODE]*** ***[FREQ OFFS MENU]*** ***[LO FREQUENCY]*** **[2.5]** **[G/n]** ***[FREQS OFFS ON]***. Then press **[MENU]** ***[TRIGGER MENU]*** ***[SINGLE]*** to put the analyzer in single sweep mode.

   For firmware revision 4.1 or higher

   Next, press **[SYSTEM]** ***[INSTRUMENT MODE]*** ***[FREQ OFFS MENU]*** ***[LO MENU]*** ***[FREQUENCY: CW]*** **[2.5]** **[G/n]** ***[RETURN]*** ***[FREQS OFFS ON]***. Then press **[MENU]** ***[TRIGGER MENU]*** ***[SINGLE]*** to put the analyzer in single sweep mode.

6. The signal level on the display should be approximately −27 dB, or equal to (HP 8753 output power) - (mixer conversion loss) - (20 dB). If the signal level is wrong or phase lock errors are present, check the setup again and then simultaneously trigger new sweeps on the HP 8753 and the signal generator by pressing ***[SINGLE]***. It may take several attempts to get the correct signal.

7. Press ***[SINGLE]*** trigger simultaneously on both the HP 8753 and the signal generator to take a clean sweep. When the sweep is finished, the marker stats should read less than 1 dB p-p (peak-to-peak). If so record PASS on the *Performance Test Record*.

8. On the HP 8753, press **[SYSTEM]** ***[INSTRUMENT MODE [FREQ OFFS MENU] [RF<LO]***. Press **[MENU]** ***[TRIGGER MENU]*** and repeat step 7.

IF THE INSTRUMENT FAILS THIS TEST

Check the setup confirm that everything is set up correctly and repeat the test.

If problems continue, perform the "Minimum R Level with External Source" performance test. If the minimum level test fails, suspect the R sampler or A11 phase lock assembly and troubleshoot as directed in the service manual. If the test passes, replace the A11 phase lock assembly.

Model Number: _____ Operator: _____

Analyzer serial number: _____ Temperature: _____

Date and time: _____ Humidity: _____

Frequency Range and Accuracy

Instrument Frequency (MHz)	Specification (±10 ppm)		Measured Value
	Lower Limit	Upper Limit	
0.3	0.299997	0.300003	
5.0	4.99995	5.00005	
16.0	15.99984	16.00016	
31.0	30.99969	31.00031	
60.999999	60.99939	61.00061	
121.0	120.99879	121.00121	
180.0	179.9982	180.0018	
310.0	309.9969	310.0031	
700.0	699.930	700.0070	
1400.0	1399.986	1400.014	
3000.0	2999.970	3000.030	

Minimum R Level

Frequency	Specification	Measured Value of Marker
300 kHz	<−35 dB	
3.29 MHz	<−35 dB	
3.31 MHz	<−35 dB	
15.90 MHz	<−35 dB	
16.10 MHz	<−35 dB	
30.90 MHz	<−35 dB	
31.10 MHz	<−35 dB	
1.6069 GHz	<−35 dB	
1.6071 GHz	<−35 dB	
3.000 GHz	<−35 dB	

Receiver Noise Level			
Measurement	**Specification**	**Measured Value**	**Step**
Input A (3 kHz IF BW)	−90 dBm 31.62 µU	_____	2
Input B (3 kHz IF BW)	−90 dBm	_____	3
Input B (10 Hz IF BW)	−100 dBm 10 µU	_____	4
Input A (10 Hz IF BW)	−100 dBm	_____	5

Input Crosstalk			
Measurement	**Specification**	**Measured Value**	Step
Input A (A/R, R into A) 300 kHz to 1 GHz	−100 dBm	_____	2
Input A (A/R, R into A) 1 GHz to 3 GHz	−90 dBm	_____	3
Input B (B/R, R into B) 1 GHz to 3 GHz	−90 dBm	_____	4
Input B (B/R, R into B) 300 kHz to 1 GHz	−100 dBm	_____	5
Input A (A/B, B into A) 300 kHz to 1 GHz	−100 dBm	_____	6
Input A (A/B, B into A) 1 GHz to 3 GHz	−90 dBm	_____	7
Input B (B/A, A into B) 1 GHz to 3 GHz	−90 dBm	_____	8
Input B (B/A, A into B) 300 kHz to 1 GHz	−100 dBm	_____	9

Trace Noise			
Measurement	**Specification**	**Measured Value**	Step
A/R Magnitude	<0.006 dB	_____	1
B/R Magnitude	<0.006 dB	_____	2
A/B Magnitude	<0.006 dB	_____	3
A/B Phase	<0.035°	_____	4
B/R Phase	<0.035°	_____	5
A/R Phase	<0.035°	_____	6

Frequency Response			
Measurement	**Specification**	**Measured Value**	Step
Input A/R Magnitude	±0.5 dB	_____	2
Input B/R Magnitude	±0.5 dB	_____	3
Input A/B Magnitude	±0.5 dB	_____	4
Input A/R Phase	±3°	_____	6
Input B/R Phase	±3°	_____	7
Input A/B Phase	±3°	_____	8

Absolute Amplitude Accuracy						
Frequency	**Power Meter Reading** Step 2	**R Input Power** Step 3	**A Input Power** Step 4	**B Input Power** Step 5	**Greatest Difference** Step 6	**Spec**
Example	−10.0	−10.14	−10.09	−10.10	0.14	±1 dB
300 kHz						±1 dB
5 MHz						±1 dB
16 MHz						±1 dB
31 MHz						±1 dB
61 MHz						±1 dB
121 MHz						±1 dB
180 MHz						±1 dB
310 MHz						±1 dB
700 MHz						±1 dB
1.5 GHz						±1 dB
2.0 GHz						±1 dB
2.5 GHz						±1 dB
3.0 GHz						±1 dB

Input Impedance					
Frequency Range	Step	**A/R (B Return Loss)**	**B/R (A Return Loss)** Step 7	**A/B (R Return Loss)** Step 8, 9	**Specification**
0.3 MHz to 2 MHz	4				>20 dB
2 MHz to 2 GHz	5				>23 dB
2 GHz to 3 GHz	6				>20 dB

Model number: _____ Operator: _____

Serial number: _____ Temperature: _____

Date and time: _____ Humidity: _____

HP 8753B/C Minimum R Level for External Source

Frequency	Frac-N VCO Frequency (MHz)		Measured Value (MHz)
	Lower Limit	Upper Limit	
10 MHz	49.496	50.496	_____
20 MHz	37.620	38.380	_____
100 MHz	49.005	49.995	_____
1 GHz	36.630	37.370	_____
3 GHz	58.216	59.392	_____

HP 8753B/C Option 002 Absolute Amplitude Accuracy

Specification: ±1 dB (16 MHz to 3 GHz)

HP 8753B/C Frequency	Source Frequency	Pwr Mtr Value	Input A Value	Input B Value	Maximum Difference
16 MHz	32 MHz	_____	_____	_____	_____
	48 MHz	_____	_____	_____	_____
31 MHz	62 MHz	_____	_____	_____	_____
	93 MHz	_____	_____	_____	_____
61 MHz	122 MHz	_____	_____	_____	_____
	183 MHz	_____	_____	_____	_____
121 MHz	242 MHz	_____	_____	_____	_____
	363 MHz	_____	_____	_____	_____
180 MHz	360 MHz	_____	_____	_____	_____
	540 MHz	_____	_____	_____	_____
310 MHz	620 MHz	_____	_____	_____	_____
	930 MHz	_____	_____	_____	_____
700 MHz	1.4 GHz	_____	_____	_____	_____
	2.1 GHz	_____	_____	_____	_____
1 GHz	2 GHz	_____	_____	_____	_____
	3 GHz	_____	_____	_____	_____
1.5 GHz	3 GHz	_____	_____	_____	_____

HP 8753B/C Option 002 and 006 Absolute Amplitude Accuracy

Specification: ±3 dB (3 GHz to 6 GHz)

Analyzer Freq.	Source Freq.	Pwr Mtr Value	Input A Value	Max. Diff.	Pwr Mtr Value	Input B Value	Max. Diff.
2 GHz	4 GHz	_____	_____	_____	_____	_____	_____
	6 GHz	_____	_____	_____	_____	_____	_____
3 GHz	6 GHz	_____	_____	_____	_____	_____	_____

HP 8753B/C Option 002 Source and Receiver Harmonics

Source Harmonics

Instrument Stop Frequency	Harmonic	Specification	Measured Value
1.5 GHz	2nd	−25 dBc	_____
1.0 GHz	3rd	−25 dBc	_____

Source and Receiver Harmonics

Instrument Stop Frequency	Harmonic	Specification	Measured Value
1.5 GHz	A: 2nd	−15 dBc	_____
1.0 GHz	A: 3rd	−30 dBc	_____
1.5 GHz	B: 2nd	−15 dBc	_____
1.0 GHz	B: 3rd	−30 dBc	_____

Receiver Harmonics

Instrument Stop Frequency	Harmonic	Specification	Measured Value
1.5 GHz	B: 2nd	−15 dBc	_____
1.0 GHz	B: 3rd	−30 dBc	_____
1.5 GHz	A: 2nd	−15 dBc	_____
1.0 GHz	A: 3rd	−30 dBc	_____

HP 8753B/C Option 002 Source and Receiver Harmonics			
Instruments with Option 006			
Source Harmonics			
Instrument Stop Frequency	**Harmonic**	**Specification**	**Measured Value**
3.0 GHz	2nd	−25 dBc	_____
2.0 GHz	3rd	−25 dBc	_____
Source and Receiver Harmonics			
Instrument Stop Frequency	**Harmonic**	**Specification**	**Measured Value**
3.0 GHz	A: 2nd	−15 dBc	_____
2.0 GHz	A: 3rd	−30 dBc	_____
3.0 GHz	B: 2nd	−15 dBc	_____
2.0 GHz	B: 3rd	−30 dBc	_____
Receiver Harmonics			
Instrument Stop Frequency	**Harmonic**	**Specification**	**Measured Value**
3.0 GHz	B: 2nd	−15 dBc	_____
2.0 GHz	B: 3rd	−30 dBc	_____
3.0 GHz	A: 2nd	−15 dBc	_____
2.0 GHz	A: 3rd	−30 dBc	_____

HP 8753 & 8702 Option 006 Minimum R Level			
Frequency	**Frac-N VCO Frequency (MHz)**		**Measured Value (MHz)**
	Lower Limit	**Upper Limit**	
4 GHz	39.198	39.990	_____
5 GHz	49.000	49.990	_____
6 GHz	58.802	59.990	_____

HP 8753B/C Option 006 Input Crosstalk			
Parameter	**Frequency**	**Specification**	**Measured Value**
R-into-A	3.5 GHz	−85 dBm	_____
	4 GHz	−85 dBm	_____
	4.5 GHz	−85 dBm	_____
	5.0 GHz	−75 dBm	_____
	5.8 GHz	−75 dBm	_____
	6.0 GHz	−75 dBm	_____
R-into-B	3.5 GHz	−85 dBm	_____
	4 GHz	−85 dBm	_____
	4.5 GHz	−85 dBm	_____
	5.0 GHz	−75 dBm	_____
	5.8 GHz	−75 dBm	_____
	6.0 GHz	−75 dBm	_____
B-into-A	3.5 GHz	−85 dBm	_____
	4 GHz	−85 dBm	_____
	4.5 GHz	−85 dBm	_____
	5.0 GHz	−75 dBm	_____
	5.8 GHz	−75 dBm	_____
	6.0 GHz	−75 dBm	_____
A-into-B	3.5 GHz	−85 dBm	_____
	4 GHz	−85 dBm	_____
	4.5 GHz	−85 dBm	_____
	5.0 GHz	−75 dBm	_____
	5.8 GHz	−75 dBm	_____
	6.0 GHz	−75 dBm	_____

HP 8753B/C Option 006 Frequency Response						
Magnitude Specification: ±2.5 dB						
Measurement	**Measured Frequency (GHz)**					
	3.5	4.0	4.5	5.0	5.5	6.0
A/R	____	____	____	____	____	____
B/R	____	____	____	____	____	____
A/B	____	____	____	____	____	____

HP 8753B/C Option 006 Frequency Response (cont'd)						
Phase Specification: ±10°						
Measurement	**Measured Frequency (GHz)**					
	3.5	4.0	4.5	5.0	5.5	6.0
A/R	____	____	____	____	____	____
B/R	____	____	____	____	____	____
A/B	____	____	____	____	____	____

HP 8753B/C Option 006 Compression					
Specification: ≤0.3 dB (3 to 6 GHz).					
Measurement	**Pwr Mtr Reading at 0 dBm**	**Input Pwr Level at 0 dBm**	**Pwr Mtr Reading at −15 dBm**	**Input Pwr Level at −15 dBm**	**Result**
4 GHz R	____	____	____	____	____
A	____	____	____	____	____
B	____	____	____	____	____
5 GHz R	____	____	____	____	____
A	____	____	____	____	____
B	____	____	____	____	____
6 GHz R	____	____	____	____	____
A	____	____	____	____	____
B	____	____	____	____	____

HP 8753B/C Option 006 Absolute Amplitude Accuracy				
Specification: ±3 dB (3 to 6 GHz)				
Instrument Frequency	**Pwr Mtr/Input R (step 2)**	**Pwr Mtr/Input A (step 3)**	**Pwr Mtr/Input B (step 4)**	**Max. Diff. (step 5)**
3.5 GHz	____	____	____	____
4.0 GHz	____	____	____	____
4.5 GHz	____	____	____	____
5.0 GHz	____	____	____	____
5.5 GHz	____	____	____	____
6.0 GHz	____	____	____	____

HP 8753B/C Optional Frequency Offset Mode		
Instrument Mode	**Specification**	**Pass/Fail**
RF>LO	<1 dB p-p	____
RF<LO	<1 dB p-p	____

Adjustments and Correction Constants

REPAIR SEQUENCE

Troubleshooting: identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

The accuracy of the HP 8753 and 8702 analyzers is achieved and maintained through mechanical adjustments and correction constants. The correction constants are empirically derived data that is stored in memory and then recalled to refine the instrument's measurements and to define its operation.

Keep the correction constants current by following the *EEPROM Backup Disk Procedure* at the end of this section: any time the A9 CPU assembly is replaced, all of the correction constants must be stored on the new assembly. For that reason, a disk with all of the analyzer's correction constants is shipped with each instrument. HP recommends that any time you perform one or several correction constant adjustments, you store the new correction constant data to disk. Then, if the A9 assembly needs to be replaced, you can simply retrieve the data rather than regenerating it by running all of the tests.

ADJUSTMENT ERROR MESSAGES

- POW MET INVALID
- POW MET NOT SETTLED
- POW MET NOT FOUND
- TROUBLE! CHECK SET-UP AND START OVER

The first three messages indicate power meter problems. Check the test setup, line power, HP-IB connections and addresses, and the model number. Repeat the test. The last message means check your setup against the illustrated setup.

ORDER OF ADJUSTMENTS

When performing more than one adjustment, perform them in this order:

Page	Adjustments and Procedures
2	A9CC Jumper Position Procedure
4	Display Intensity and Focus Correction Constants (HP 8753A/B and 8702A)
5	Display Image Size, Position and Trace Alignment Adjustments (HP 8753A/B and 8702A)
7	Vertical Position and Focus Adjustments (HP 8753C and 8702B)
9	Display Degaussing Adjustment (HP 8753C and 8702B)
10	Display Intensity Adjustments (HP 8753C and 8702B)
13	Serial Number Correction Constant
14	Option Numbers Correction Constant
16	Analog Bus Correction Constants
17	ADC Linearity Correction Constants
18	Fractional-N Frequency Range Adjustment
21	Source Default Correction Constants
22	Source Pretune Correction Constants
23	Frequency Accuracy Adjustment
25	High/Low Band Transition Adjustment
27	Fractional-N Spur and FM Sideband Adjustment
30	Source Spur Avoidance Tracking Adjustment
32	Sampler Diode Bias Adjustment (HP 8753A/B and 8702A)
35	Sampler Magnitude and Phase Correction Constants
41	RF Output Power Correction Constants
45	IF Amplifier Correction Constants
47	Cavity Oscillator Correction Constants
52	Cal Kit Default Correction Constants
53	EEPROM Backup Disk Procedure

TEST EQUIPMENT

See the *Table of Service Test Equipment* in the *Service and Equipment Overview*.

INSTRUMENT COVER REMOVAL

See the illustration on the *Troubleshooting and Block Diagram* tab. The covers need not be removed for routine maintenance.

A9 CC (CORRECTION CONSTANT) JUMPER POSITION

Move the A9 CC jumper, as explained next, to the ALTER position to change correction constants. The instrument is shipped, and should be operated, with the A9 CC jumper in the NORMAL position.

A9 CC Jumper Position Procedure

1. Remove the instrument top cover and PC board stabilizer.



Turn off power before removing or installing assemblies.

2. The location of the assemblies in the upper portion of the instrument is shown on the inside of the top cover. Remove the A9 CPU assembly and move the A9 CC jumper to the ALTER position as shown on the *Adjustments* tab.

3. Replace the A9 assembly and run the correction constant routine(s).

4. Return the A9 CC jumper to the NORMAL position when finished.

NOTE: Update the EEPROM backup disk by performing the *EEPROM Backup Disk Procedure*.

Display Intensity and Focus Correction Constants (HP 8753A/B and 8702A)

NOTE: After installing a display in the analyzer, immediately check the power supply voltages as outlined in *Power Supply*.

DESCRIPTION AND PROCEDURE

This procedure stores the display intensity and focus settings as correction constants.

Equipment required: none. Warm-up time: 5 minutes.

1. Check A9 CC jumper position. In the RESPONSE area of the front panel, press **[DISPLAY]**. Then press the bottom softkey, ***[MORE]***. The top five softkeys (which may not be legible) are:

   [SPLIT DISP on OFF]
   [BEEP DONE ON off]
   [BEEP WARN on OFF]
   [INTENSITY]
   [FOCUS]

2. Press ***[INTENSITY]*** (fourth softkey from the top) and rotate the RPG knob clockwise to increase the intensity of the display; counterclockwise, to decrease.

3. Press ***[FOCUS]*** (fifth softkey from the top) and rotate the RPG knob for best focus. The intensity and focus adjustments are slightly interactive.

4. Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[4]** **[9]** **[x1]**. When the CRT displays "Foc/Int Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constants and observe the CRT:

- "DONE" displayed: the adjustment is done. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.
- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.
- Continued improper operation: refer to *Isolate Faulty Group* to troubleshoot the problem.

Display Image Size, Position and Trace Alignment Adjustments (HP 8753A/B and 8702A)

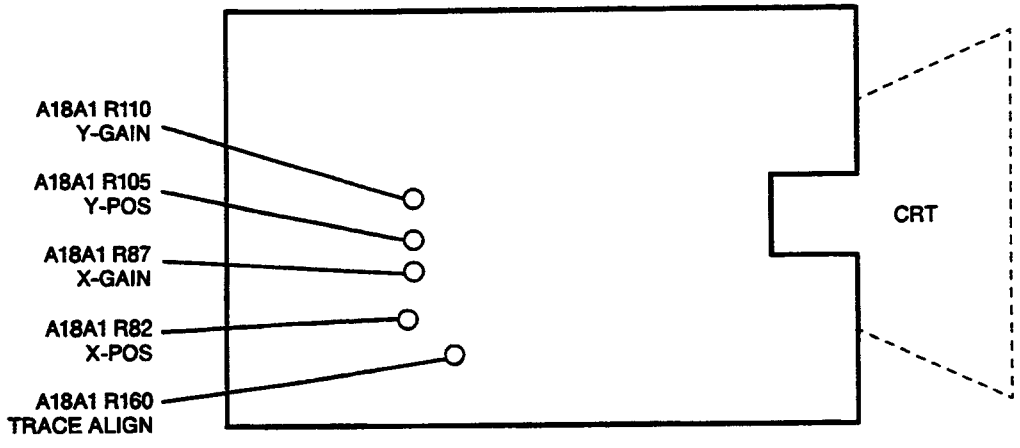


Figure 1. Gain, Position and Alignment Adjustment Locations

DESCRIPTION AND PROCEDURE

The horizontal and vertical gain and position adjustments are made with four potentiometers on the A18A1 assembly on the underside of the display. The trace alignment potentiometer is on the same assembly, as shown in Figure 1.

Equipment required: none. Warm-up time: 5 minutes.

1. The initial screen should show a graticule 13.5 cm (5.25 in) wide and 11.4 cm (4.5 in) high. The graticule should not be centered on the screen because the notations which appear at its four sides differ in size. It should appear level, not slanted.

2. If the display appears as described above, no adjustments are required.

   Otherwise, turn off the analyzer, remove the top cover and the A9 CPU assembly. Place the instrument on edge and remove the bottom cover.

3. Make the following adjustments:

Reference Designator	Adjustment	Description
A18A1R110	Y-gain	Adjust for a 12 cm (4.75 in) high display.
A18A1R105	Y-position	Adjust to vertically center image.
A18A1R87	X-gain	Adjust for a 17 cm (6.75) wide display.
A18A1R82	X-position	Adjust to horizontally center image.
A18A1R160	trace align	Adjust for level image.

4. If the adjustments are ineffective, check the voltages as outlined in *Digital Control*. If the voltages are correct, replace the display.

Vertical Position and Focus Adjustments (HP 8753C and 8702B)

No display adjustments, other than those in this manual, can be performed in the field (this includes both customers and service centers). Any other adjustments to the display will void the warranty. These adjustments are optional as they have been performed at the factory and should rarely require adjustment in the field.

DESCRIPTION AND PROCEDURE

Equipment required: none. Warm-up time: 30 minutes

Vertical Adjustment

1. To access vertical and focus adjustments controls, remove the side panel nearest the display.

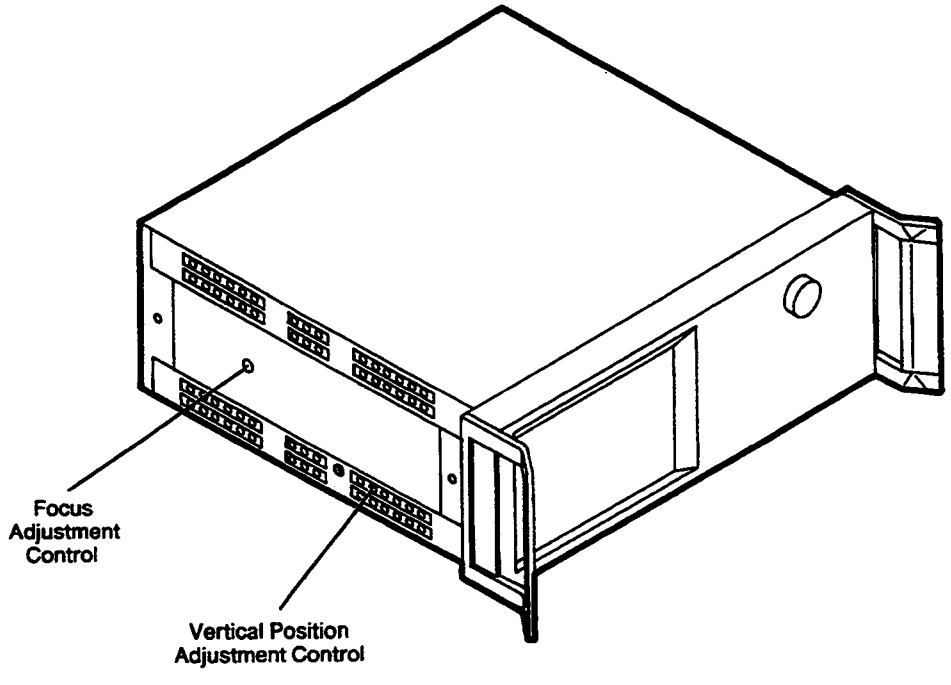


Figure 2. Vertical Position and Focus Adjustment Controls

2. Insert a narrow, preferably non conductive, flat head screw driver (at least 2 inches long) into the vertical position hole.

3. Adjust the control until the softkey labels are aligned with the softkeys.

Focus Adjustment

4. Use screwdriver as in step 3 to adjust the focus until display has the most readability.

Display Degaussing (Demagnetizing) (HP 8753C and 8702B)

EQUIPMENT

Any CRT Demagnetizer or
Bulk Tape Eraser

DESCRIPTION AND PROCEDURE

As with all color monitors, the display is very susceptible to external magnetic fields. These fields can originate from many sources including metal frame tables and from the earth itself. The usual symptom is a discoloration or slight dimming of the display usually near the top left corner of the CRT. In extreme cases, a total color shift may be observed; for example, a trace that was red may shift to green. This does not indicate a problem with the display; it is characteristic of all color displays. Should the display become magnetized, or if color purity is a problem, cycle the power several times. Leave the instrument off for at least 15 seconds before turning it on. This will activate the automatic degaussing circuit in the display. If this is insufficient to achieve color purity, a commercially available demagnetizer must be used (either a CRT demagnetizer or a bulk tape eraser can be used). Follow the manufacturer's instructions keeping in mind the following: it is imperative that at first it be placed no closer than 4 inches (10 cm) from the face of the CRT while demagnetizing the display. If this distance is too far to completely demagnetize the CRT, try again at a slightly closer distance until the CRT is demagnetized.



Applying an excessively strong magnetic field to the CRT face can permanently destroy CRT.

Like most displays, the CRT can be sensitive to large magnetic fields generated from unshielded motors. In countries that use 50 Hz, some 10 Hz jitter may be observed. If this problem is observed, remove the device causing the magnetic field.

Display Intensity Adjustments (HP 8753C and 8702B)

EQUIPMENT

Photometer	Tektronix J16 Photometer
Probe	Tektronix J6503
Light Occluder	Tektronix 016-0305-00

DESCRIPTION AND PROCEDURE

There are three display intensity adjustments: background, maximum, and operating default. In general, these adjustments should not be required. However, when either the A19 GSP, A9 CPU, or A18 display assemblies are replaced, perform a visual inspection of the display. If it appears to need adjustment, proceed with these adjustments.

NOTE: This procedure should be performed with a photometer and only by qualified service personnel.

Warm-up time: 30 minutes.

Background Adjustment

1. Remove the top cover of the analyzer (refer to the figure on the *Adjustments* tab. Check that the jumper on A9 CPU is in the ALTER position.

2. In a dimly lit room (or with the analyzer CRT shaded from bright lights), press **[PRESET] [SYSTEM]** ***[SERVICE MENU]*** (softkey 8) ***[TESTS]*** (softkey 1) **[49] [x1]**.

3. The CRT should display:

   Intensity Cor –ND–

NOTE: The display could be so far out of adjustment that the annotation will be very difficult to read.

4. Press ***[EXECUTE TEST]*** (softkey 1) and ***[YES]*** (softkey 2) at the prompt to alter the correction constants. Alternating vertical bars of three different intensities will be drawn on the CRT. Each bar has a number written below it (either 0, 1, or 2).

5. Adjust the analyzer front panel knob until the vertical bar labeled "1" is just barely visible against the black border. Vertical bar "0" must not be visible.

With no changes to the analyzer, continue with the next test.

Maximum Intensity Adjustment

This adjustment ensures that the light output at the 100% intensity level is equal to, or less than, 150 NITs. The level is set using a photometer to measure the output light. One-hundred percent is the maximum intensity level of light output from the display.

CAUTION

Operating the display at intensities higher than 150 NITs may reduce the life of the display.

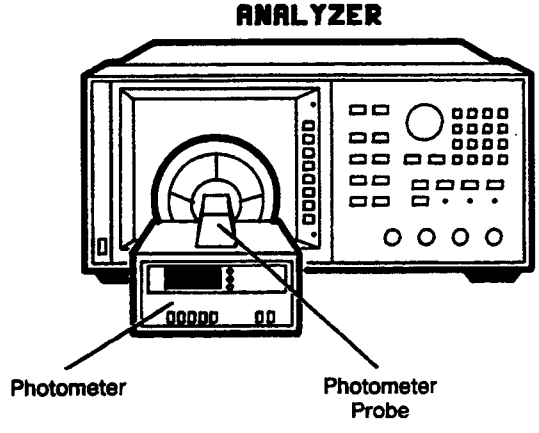


Figure 3. Maximum Intensity Adjustment Set-up

6. Press the top softkey.

7. Set the photometer probe to NORMAL. Press **[POWER]** on the photometer to turn it on and allow 30 minutes warm-up. Zero the photometer according to the manufacturer's instructions. The analyzer CRT should have an all white screen.

8. Center the photometer on the analyzer CRT as shown in Figure 3. Adjust the analyzer front panel knob to the maximum (clockwise) position. If the photometer registers greater than 150 NITs, turn the front panel knob until a reading of no more than 150 NITs registers on the photometer. If the photometer registers a reading of less than 150 NITs and greater than 100 NITs, proceed to the next step. If the photometer registers a reading of less than 100 NITs, the display is faulty.

NOTE: The above intensity levels are read without a display bezel installed. The glass filter transmits 60% of the display light, therefore 150 NITs would be 90 NITs with the bezel installed.

Operating Default Intensity Adjustment

This adjustment sets the default level display intensity. The analyzer normally presets to the same intensity level that was last used. This level is stored in volatile memory. If you power on and off, the memory is lost. Then the analyzer will use the default display intensity to ensure that the display is visible and eliminate concern that the display may not be functioning.

9. Press the top softkey on the analyzer to bring up the next display adjustment mode.

10. Center the photometer on the analyzer CRT as shown in Figure 3. Adjust the analyzer front panel knob until the photometer registers 100 NITs of output light if the glass bezel assembly is not installed. Adjust for 60 NITs if the glass bezel is installed.

11. Press the top softkey on the analyzer and observe the CRT:

- "DONE" displayed: the adjustment is done. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants. This completes the series of three *Display Intensity Adjustments*.

- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.

- Continued improper operation: refer to *Troubleshooting* to isolate the problem.

Serial Number Correction Constant

DESCRIPTION AND PROCEDURE

This procedure customizes the replacement A9 CPU assembly by storing the instrument's unique serial number as a correction constant in EEPROM.

Equipment required: none. Warm-up time: 5 minutes.



Perform this procedure ONLY if the A9 CPU assembly has been replaced.

1. Move the A9 CC jumper to the ALTER position. Note the ten character serial number on the rear panel identification label.

2. Press **[PRESET]** **[DISPLAY]** ***[MORE]*** ***[TITLE]*** ***[ERASE TITLE]*** to erase the HP logo.

   Rotate the RPG knob to position the arrow below each character of the instrument serial number and press ***[SELECT LETTER]*** to enter each in turn. Enter a total of ten characters: four digits, one letter, and five final digits.

   Press ***[BACKSPACE]*** or ***[ERASE TITLE]*** to correct errors. Press ***[DONE]*** when the title is complete and correct.



Mistakes cannot be corrected after step 3 is performed.

3. Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[5]** **[5]** **[x1]**. When the display shows "Serial Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constant.

4. To check the serial number recognized by the instrument, move the A(CC jumper to the NORMAL position. Press **[PRESET]** and repeat step 3. However, the test should fail because a serial number has already been stored. To check the serial number recognized by the instrument, press **[DISPLAY]** ***[MORE]*** ***[TITLE]***. The number displayed in the title area of the CRT (upper left) should be the instrument serial number. If not perform step 5.

5. If this procedure did not end with "DONE", either the A9 CC jumper was not in the ALTER position, the serial number entered did not conform to the required format or a valid serial number was already stored. In any case, confirm that the A9 CC jumper is in the ALTER position, confirm that the serial number is correct, and repeat this procedure. Contact HP if the procedure still does not end with "DONE".

Option Numbers Correction Constant

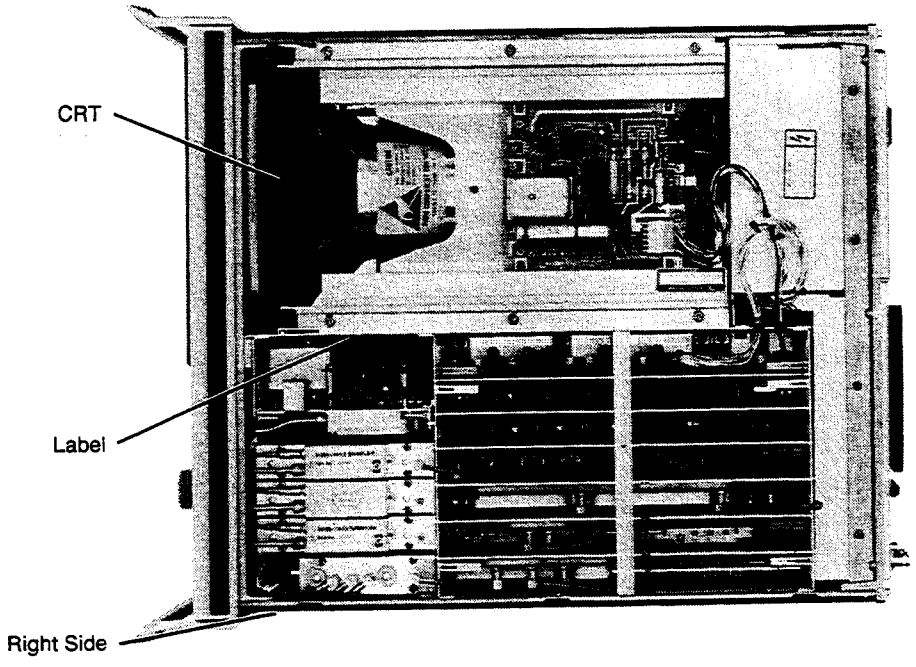


Figure 4. Location of Keyword Label (HP 8753B only)

DESCRIPTION AND PROCEDURE

Special information is stored on the A9 CPU assembly of instruments with option 002 (harmonics) or 006 (6 GHz operation) or 010 (time domain) or any combination. This procedure restores that information. Equipment required: none. Warm-up time: 5 minutes.

Perform this procedure *only* if:

(1) the instrument has option 002 or 006 or 010, AND
(2) the A9 CPU assembly has been replaced, AND
(3) the serial number correction constant procedure has been performed.

1. Check the A9 CC jumper position. Remove the instrument top cover and note the keyword label in the source cavity (see Figure 4). The label has one keyword for each option installed in the instrument. If the instrument lacks a label, call your local HP Sales and Service office to obtain the keyword(s). Be prepared to tell HP the full serial number on the rear panel of the instrument.

2. Press **[PRESET] [DISPLAY]** ***[MORE] [TITLE] [ERASE TITLE]***. Rotate the RPG knob to position the arrow below each character of the first keyword, and press ***[SELECT LETTER]*** to enter each in turn. Do not confuse "I" with "1" or "O" with "0" (zero).

   Press ***[BACKSPACE]*** or ***[ERASE TITLE]*** to correct errors. When the title is complete and correct, press ***[DONE]***.

3. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [6] [x1]**. When the display shows "Option Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constant and observe the CRT:

- "DONE" displayed: the adjustment is done. Continue with step 4.
- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.
- "Fail" displayed: check the keyword again to make sure it is correct, especially if it contains the letters "I" or "O" or the numbers "1" or "0". Repeat the procedure beginning with step 2.

  If the procedure still fails, contact HP.

4. If the instrument has more than one option (and keyword), repeat steps 2 and 3 to enter the remaining keywords. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.

Analog Bus Correction Constants

DESCRIPTION AND PROCEDURE

This procedure calibrates the analog bus by using three reference voltages (ground, +0.37V and +2.5V). It then stores the calibration data as correction constants in EEPROM.

Equipment required: none. Warm-up time: 30 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [6] [x1]**. When the display shows "ABUS Cor", press ***[EXECUTE TEST]*** and then press ***[YES]*** at the query to alter the correction constants and observe the CRT:

- "DONE" displayed: the adjustment is done. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.
- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.
- Continued improper operation: refer to *Digital Control* to troubleshoot the problem.

ADC Linearity Correction Constants

DESCRIPTION AND PROCEDURE

These correction constants improve dynamic accuracy by shifting small signals to the most linear part of the ADC quantizing curve.

Equipment: RF cable, RF OUT to R. Warm-up time: 5 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [2] [x1]**. When the CRT displays "ADC Ofs Cor", press ***[EXECUTE TEST]***.

2. Press ***[YES]*** at the query to alter the correction constants. This test is fairly long. Observe the CRT:

- "DONE" displayed: the adjustment is done. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.
- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.
- Continued improper operation: refer to *Digital Control* to troubleshoot the problem.

Fractional-N Frequency Range Adjustment

EQUIPMENT

Extender board	part of tool kit HP p/n 08753-60023
RF cable	from HP 11851B cable set
SMB cables (2)	part of above tool kit

DESCRIPTION AND PROCEDURE

This adjustment centers the fractional-N VCO (voltage controlled oscillator) in its tuning range to insure reliable operation of the instrument. Warm-up time: 30 minutes.

1. Remove the instrument top cover (see *Adjustments* tab) and install the A14 assembly (yellow extractors) on the extender board. Use SMB cables as required. Connect the RF cable from RF OUT to R.

2. Press **[PRESET] [DISPLAY]** ***[DUAL CHAN ON]*** **[SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MENU]** ***[NUMBER of POINTS]*** **[1] [1] [x1]** ***[COUPLED CH OFF]***.

3. Press **[START] [3] [6] [M/u] [STOP] [6] [0] [.] [7] [5] [M/u] [MENU]** ***[SWEEP TIME]*** **[1] [2] [.] [5] [k/m] [MEAS]** ***[S PARAMETERS] [ANALOG IN]*** **[2] [9] [x1]** to observe the "FN VCO Tun" voltage.

   Press **[FORMAT]** ***[MORE] [REAL]*** **[SCALE REF] [.] [6] [x1]** ***[REFERENCE VALUE]*** **[–] [7] [x1]** to set and scale channel 1. Then press **[MKR]** to set the marker to the far right of the graticule.

4. Press **[CH 2] [MENU]** ***[CW FREQ]*** **[3] [1] [.] [0] [0] [0] [1] [M/u]** ***[SWEEP TIME]*** **[1] [2] [.] [3] [7] [5] [k/m] [MEAS]** ***[S PARAMETERS] [ANALOG IN]*** **[2] [9] [x1]** to observe the "FN VCO Tun" voltage.

   Then press **[FORMAT]** ***[MORE] [REAL]*** **[SCALE REF] [.] [2] [x1]** ***[REFERENCE VALUE]*** **[6] [.] [7] [7] [x1] [MKR] [6] [k/m]** to set channel 2 and its marker.

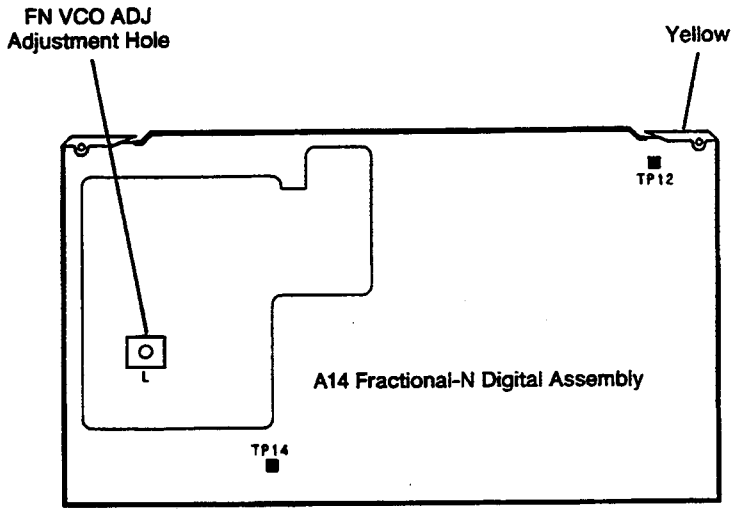


Figure 5. FN VCO TUNE Adjustment Location

5. Adjust "FN VCO TUNE" (see Figure 5) with a non-metalic tool so that the channel 1 marker is as many divisions above the reference line as the channel 2 marker is below it (see Figure 6).

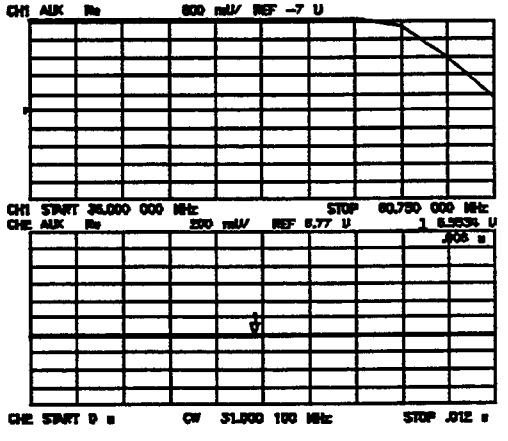


Figure 6. Fractional-N Frequency Range Adjustment Display

6. To fine-tune this adjustment, press **[PRESET]** **[MENU]** ***[CW FREQ]*** **[SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** ***[SERVICE MODES]*** ***[FRACN TUNE ON]*** to set "FRAC N TUNE" to 29.2 MHz. Then press **[MEAS]** ***[S PARAMETERS]*** ***[ANALOG IN]*** **[2]** **[9]** **[x1]** **[MKR]** **[FORMAT]** ***[MORE]*** ***[REAL]*** **[SCALE REF]** ***[REFERENCE VALUE]*** **[7]** **[x1]** and observe the marker:

- Marker value less than 7: the adjustment is done.
- Marker value is greater than 7: readjust "FN VCO ADJ" to 7. Then perform steps 2 through 4 to confirm that the channel 1 marker is still above the reference line and cannel 2 below. The markers need not be equally far from the reference lines.

7. If proper adjustment is not possible, replace A14.

Source Default Correction Constants

DESCRIPTION AND PROCEDURE

This internal adjustment test writes default correction constants for rudimentary source power accuracy. This adjustment must be performed before the *Source Pretune Correction Constants* procedure. Although it need not be done immediately, the *RF Output Power Correction Constants* procedure must be performed at some time following this adjustment.

1. Check that the A9 CC jumper is in the ALTER position.

2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[44] [x1]**. When the display shows "Source Def −ND−", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constants.

3. When complete, "DONE" should appear on the CRT. Use a power meter or oscilloscope to verify that source power can be controlled and that the power level is approximately correct. The *RF Output Power Correction Constants* procedure will provide a more precise adjustment of power.

   If "FAIL" appears on the CRT, refer to *Source Troubleshooting*.

Source Pretune Correction Constants

DESCRIPTION AND PROCEDURE

This adjustment generates two correction constants which pretune the YIG oscillators to insure proper phase lock. This procedure begins with running test 45 to preload memory with default values.

Equipment required: RF cable, RF OUT to R. Warm-up time: 30 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [5] [x1]**. When the CRT displays "*Pretune Def", press ***[EXECUTE TEST]***.

2. Press ***[YES]*** at the query to alter the correction constants and observe the CRT:

- "DONE" displayed: the preliminary adjustment is done; do step 3.

- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.

3. Press **[4] [8] [x1]**. When the CRT displays "Pretune Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constants and observe the CRT:

- "DONE" displayed: the adjustment is done and can be tested by pressing **[PRESET]** and again observing the CRT:

- Normal operation observed: the adjustment is good. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.

- Error messages observed: refer to *Source.*

- "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Postion* to reposition jumper; rerun routine.

- Continued improper operation: refer to *Source* to troubleshoot the problem.

Frequency Accuracy Adjustment

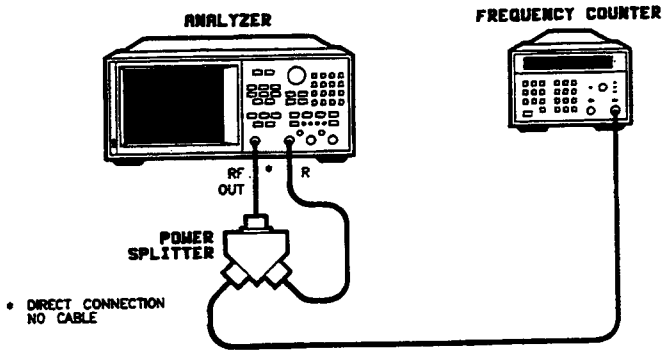


Figure 7. Frequency Accuracy Adjustment Setup

EQUIPMENT

Frequency counter	HP 5343A
RF cable	HP 85131C/D
Power splitter	HP 11667A option 001

DESCRIPTION AND PROCEDURE

This adjustment sets the VCXO (voltage controlled crystal oscillator) frequency to maintain the instrument's frequency accuracy. Warm-up time: 30 minutes.

1. Remove the instrument top cover (see the *Adjustments* tab). Connect the power splitter to the analyzer's RF OUT and connect its outputs to input R of the analyzer and to the frequency counter input (see Figure 7).

2. Press **[PRESET] [MENU]** ***[CW FREQ]*** **[5] [0] [M/u]** and note the frequency:

   - Frequency = 50 MHz ±500 Hz: no adjustment is required.
   - To adjust the frequency, locate the A12 assembly (red extractors) and adjust VCXO ADJ (see Figure 8) for a frequency counter reading as close to 50 MHz as possible. It must be within 500 Hz.

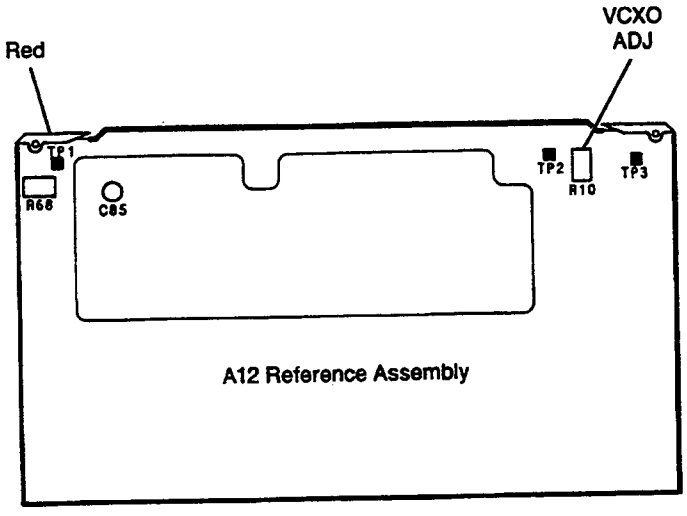


Figure 8. VCXO ADJ Adjustment Location

3. If you are unable to adjust the frequency as specified, replace the A12 assembly.

High/Low Band Transition Adjustment

DESCRIPTION AND PROCEDURE

This adjustment centers the VCO (voltage controlled oscillator) of the A12 reference assembly for reliable high band and low band operation.

Equipment required: none. Warm-up time: 30 minutes.

1. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[START] [1] [1] [M/u] [STOP] [2] [1] [M/u]** to observe part of both the low and high bands on the analog bus.

2. Press **[MEAS]** ***[S PARAMETERS] [ANALOG IN]*** **[2] [2] [x1] [FORMAT]** ***[MORE] [REAL]*** **[DISPLAY]** ***[DATA]***MEM] [DATA-MEMORY] to subtract the ground voltage from the next measurement.

3. Press **[MEAS]** ***[S PARAMETERS] [ANALOG IN]*** **[2] [3] [x1] [MKR] [1] [1] [M/u] [MKR FCTN]** and position the marker on the left side of the trace. Then press ***[MARKER->REFERENCE]*** **[SCALE REF] [.] [1] [x1]** and observe the VCO tune voltage trace:

   - Left half of trace = 0 ± 1000 mV and right half of trace = 100 to 200 mV higher (one to two divisions, see Figure 9): no adjustment necessary.

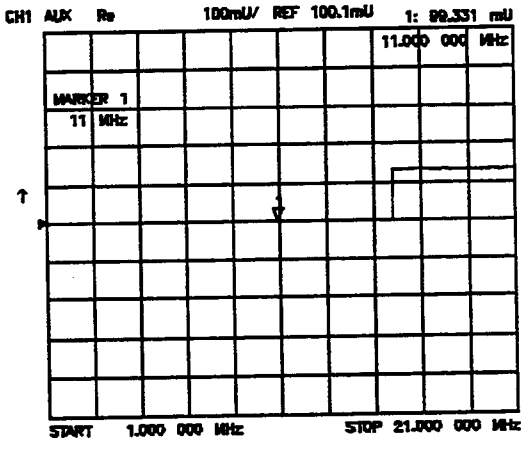


Figure 9. High/Low Band Transition Adjustment Trace

   - To adjust, turn VCO TUNE (see Figure 10) to position the left half of the trace to 0 ± 125 mV.
   - Then adjust HBLB to position the right half of the trace 125 to 175 mV (about 1-1/2 divisions) **higher** than the left half.

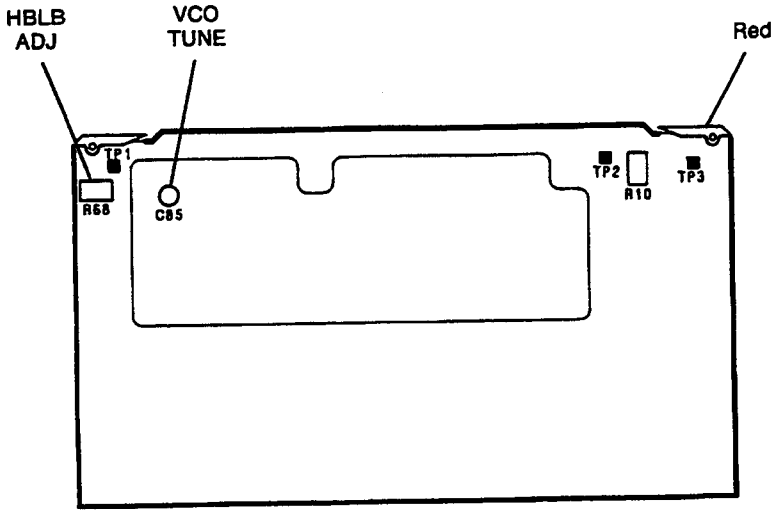


Figure 10. High/Low Band Adjustments Locations

4. In case of difficulty, refer to *Source* to troubleshoot the problem.

Fractional–N Spur Avoidance and FM Sideband Adjustment

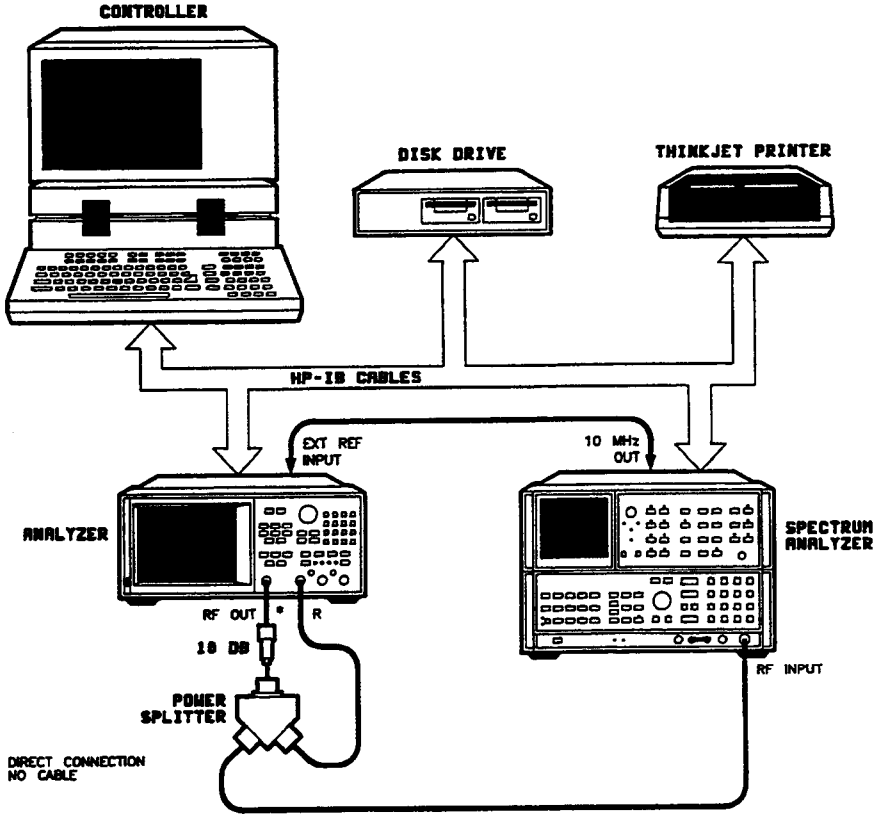


Figure 11. Fractional–N Spur Avoidance and FM Sideband Adjustment Setup

EQUIPMENT

Spectrum analyzer	HP 8566A/B
Disk drive	HP 9122S/D
Controller	HP 9000, model 216, 220, 226, 236 or 310
Printer	HP 2225A
HP-IB cable (4)	HP 10833A/B/C/D
BNC cable	HP part number 8120-1840
RF cable set	HP 11851B
Power splitter	HP 11667A option 010
10 dB attenuator	HP 8491A option 010
Automated adjustment software disk	see *Replaceable Parts*

DESCRIPTION AND PROCEDURE

This adjustment minimizes the spurs caused by the API (analog phase interpolator, on the fractional-N assembly) circuits. It also improves the FM sideband characteristics. Warm-up time: 30 minutes.

1. Connect the equipment as shown in Figure 11.

2. Make sure the instruments are set to their default HP-IB addresses:

Disk drive	00
Printer	01
HP 8753, 8702A	16
Spectrum analyzer	18

3. Load the BASIC operating system and the required binaries (ERR, GRAPH, IO, KBD, MAT, MS, CS80, HPIB and CRTA).

   HP 8702 ONLY: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]***.

4. Insert the analyzer automated adjustment software disk into the disk drive, type LOAD "API ADJ" and press **[ENTER]** or **[RETURN]** on the controller.

5. Press **[RUN]** and then press any key. The program will begin with a calibration.

NOTE: The signal to be nulled is automatically centered; disregard all others.

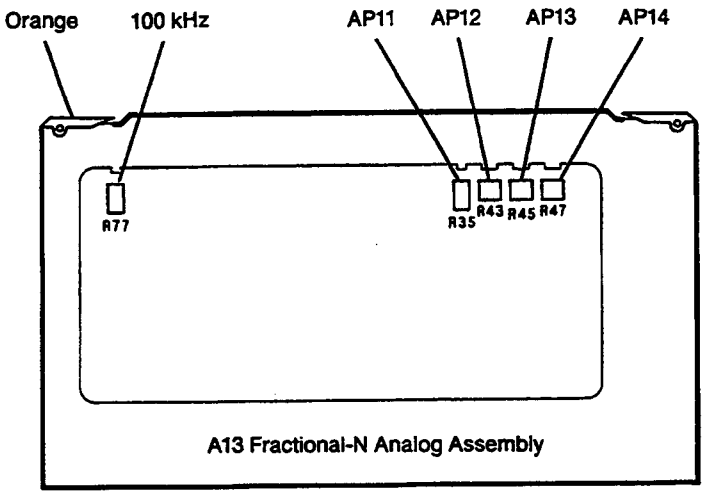


Figure 12. Location of API and 100 kHz Adjustments

6. When prompted, adjust API1 (see Figure 12) for minimum signal amplitude. Press any key to continue.

7. Repeat step 6 to adjust API2, API3, API4 and 100kHZ.

8. In a minute, a composite plot should appear below the specification trace on the controller CRT. On the controller press:

   [HRDCOPY] to print a hardcopy of the plot.
   [NEXT] to continue the program.

   [RE-PLOT] to optimize the plot. When optimizing, do not use the response on the spectrum analyzer. Optimization involves all of the spurs, not just the one visible.

   Turn API1 one-half turn CCW (counter-clockwise) and press **[RE-PLOT]**. If the data trace is now worse than the previous trace, turn API1 CW (clockwise) one turn and press **[RE-PLOT]**. Continue in this manner until the data trace is optimized and then press **[NEXT]**.

9. The next plot will be that of the 100 kHz spurs. Repeat step 8 using the 100 kHz adjust in place of API1. Press **[NEXT]** on the controller to complete this procedure.

10. If the adjustment can not be performed satisfactorily, repeat the entire procedure. In case of continuing difficulty, replace A13.

Source Spur Avoidance Tracking Adjustment

EQUIPMENT

RF cable	part of HP 11851B
BNC-alligator clip adapter	HP p/n 8120-1292
BNC cable	HP p/n 8120-1839

DESCRIPTION AND PROCEDURE

This adjustment optimizes tracking between the YO (YIG oscillator) and the cavity oscillator when they are frequency offset to avoid spurs. Optimizing YO-cavity oscillator tracking reduces perturbations to the phase-locked loop. Warm-up time: 30 minutes.

1. Connect the RF cable from RF OUT to input R. Mate the adapter to the BNC cable and connect the BNC connector end to AUX INPUT on the rear panel. Connect the BNC center conductor alligator-clip to A11TP10 (labeled D ERR); the shield clip to A11TP1 (GND), shown in Figure 13.

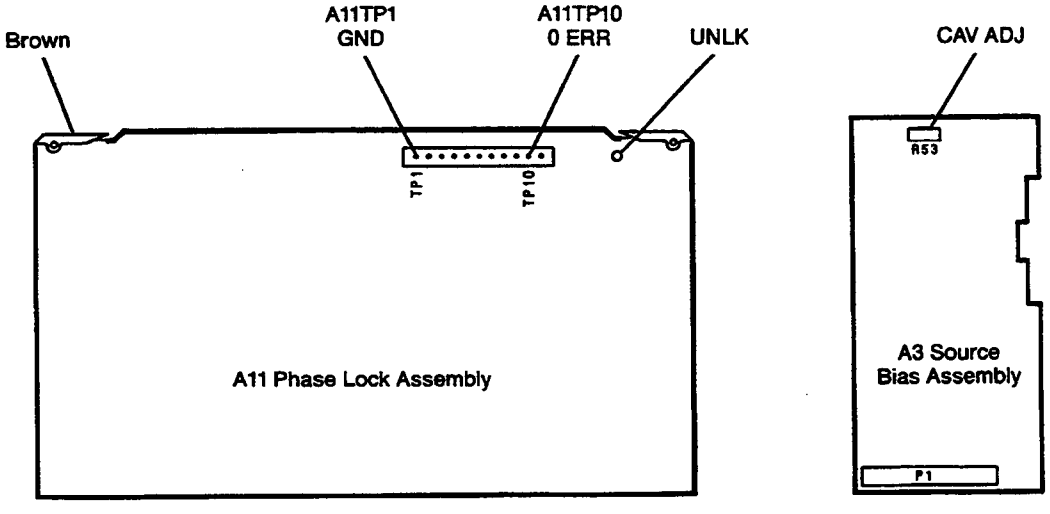


Figure 13. A11 Test Point and A3 CAV ADJ Locations

2. Press **[PRESET] [CENTER] [4] [0] [0] [M/u] [SPAN] [5] [0] [M/u]** to generate a sweep from 375 MHz to 425 MHz.

3. Then press **[SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** **[MEAS]** ***[S PARAMETERS]*** ***[ANALOG IN]*** **[1] [1] [x1] [FORMAT]** ***[MORE]*** ***[REAL]*** **[SCALE REF] [1] [0] [k/m]** ***[MARKER]*** REFERENCE] to observe the phase-locked loop error voltage.

   - "Spikes" are not visible on CRT (see Figure 14): no adjustment is necessary.
   - Spikes are excessive (see Figure 14): adjust the CAV ADJ potentiometer (see Figure 13) on the A3 source bias assembly to eliminate the spikes.

4. Refer to the *Troubleshooting* section if visible spikes persist.

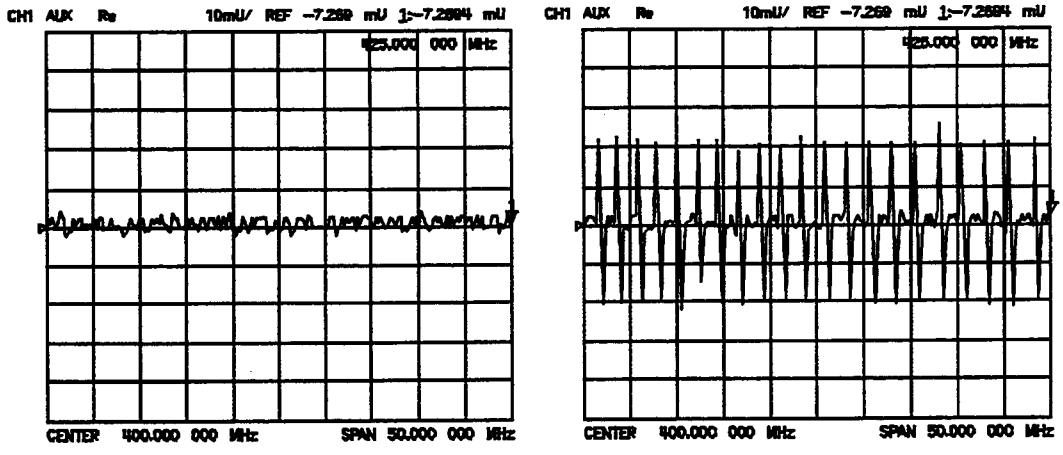


Figure 14. Display of Acceptable versus Excessive Spikes

Sampler Diode Bias Adjustment (HP 8753A, 8753B*, and 8702A)

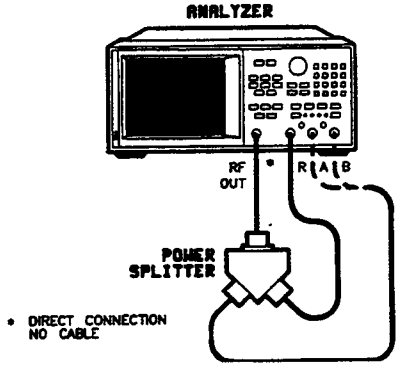


Figure 15. Sampler Diode Bias Measurement Setup

EQUIPMENT

Power splitter	HP 11667A option 001
RF cable set	HP 11851B
Extender board, small	part of tool kit 08753-60023
Rigid cable SMA (m)	HP p/n 08753-20028 (part of tool kit 08753-60023)
Adapter SMA (f)/N (m)	HP p/n 1250-1250 (part of tool kit 08753-60023)
Adapter N (f)/N (f)	HP p/n 1250-1472

NOTE: In this procedure, input R is used as an example. Substitute A or B as required.

DESCRIPTION AND PROCEDURE

This adjustment balances the band step size and the high frequency rolloff for optimum performance by setting the length of time that the sampler diodes are turned on. Warm-up time: 30 minutes.

1. Connect the equipment as shown in Figure 15: to adjust inputs R or A, apply RF power to inputs R and A; to adjust input B, apply RF power to inputs R and B.

   HP 8702A ONLY: Press **[PRESET] [CAL]** ***[DEVICE TYPE] [E/E]; do NOT press PRESET in step 2.***

   *This adjustment is not present and therefore cannot be performed on some HP 8753Bs. See Figure 18 for the location of the bias adjustment.

2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [MORE] [SAMPLR COR OFF]*** **[CH 2]** ***[SAMPLR COR OFF]*** to turn off sampler correction. Then press **[MENU]** ***[COUPLED CH OFF]*** **[CH 1] [MEAS]** ***[R]*** to measure the uncoupled response of the sampler.

3. Press **[START] [3] [5] [M/u] [STOP] [9] [5] [M/u] [SCALE REF] [.] [5] [x1]** ***[MARKER->REFERENCE]*** to display the sampler band step size on channel 1.

   Press **[DISPLAY]** ***[DUAL CHAN ON]*** **[CH 2] [MEAS]** ***[R]*** **[START] [4] [5] [M/u]** to display the sampler rolloff on channel 2. Adjust the scale and reference as required. Observe the traces:

   - Band step size = 0.2 to 0.8 dB,
     Sampler rolloff = 1.5 to 3.5 dB (as shown in Figure 16):
     no adjustment is necessary.

   - To adjust: press **[SAVE]** ***[REG1]*** and perform steps 4 through 6.

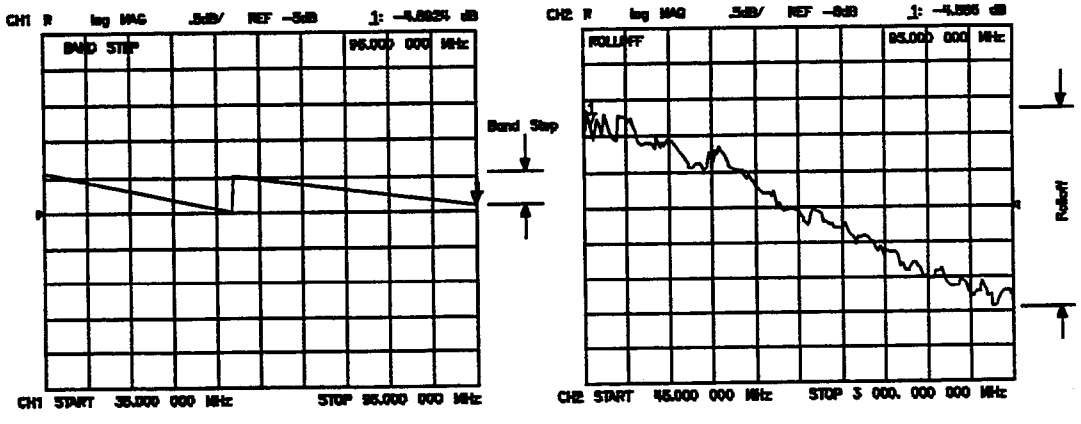


Figure 16. Band Step Size and Sampler Rolloff

4. Turn off the instrument and remove the top cover. Note: input R uses sampler A4; A uses A5; B uses A6. Remove the four screws that fasten the cover of the sampler assembly. Unplug the flexible SMB cable (the R sampler has 2 SMB cables). Unscrew and detach the rigid SMA cable. Withdraw the sampler board.

5. Place the sampler board on the small extender board and reconnect the flexible SMB cable(s). Use extension cable(s) as required. Disconnect the cable on the front panel input R and reconnect it to the SMA connector of the sampler. Use the rigid extender cable, an SMA (f)/type-N (m) adapter and a type-N (f)/type-N (f) adapter as illustrated in Figure 17.

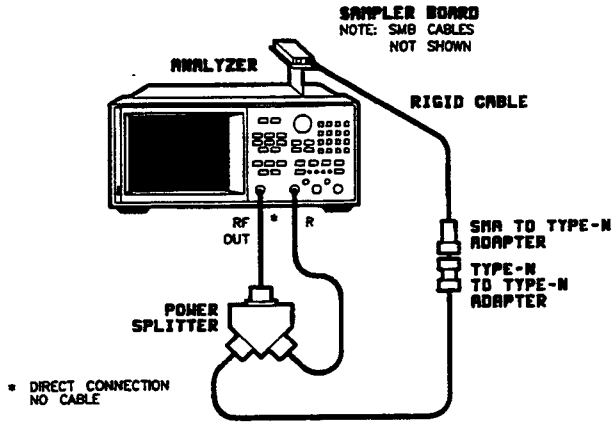


Figure 17. Cable Connections with Sampler on Extender Board

6. Turn on the analyzer and press **[RECALL]** ***[REG1]***. Adjust the potentiometer shown in Figure 16 to meet the criteria of step 3. When reassembling the instrument, make sure the four sampler board cover screws are reinstalled tight enough (very tight) to prevent leakage and crosstalk.

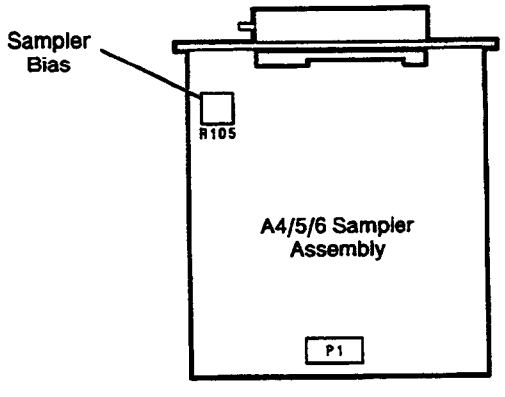


Figure 18. Sampler Diode Bias Adjustment Location

7. Following this procedure you should perform the *RF Output Power Correction Constants* and the *Sampler Magnitude and Phase Correction Constants* adjustments.

8. If you were unable to meet the specifications, refer to the *Receiver* section.

Sampler Magnitude and Phase Correction Constants

EQUIPMENT

Power meter	HP 436A option 002 or HP 438A
Power sensor	HP 8482A
Power splitter	HP 11667A option 001
Cables (2)	HP 11500B (2 identical, high quality cables)
Adapter N(f)/N(f)	HP p/n 1250-1472
Adapter N(m)/N(m)	HP p/n 1250-1475

Additional equipment required for HP 8753B with option 006

Power sensor	HP 8481A
Adapter 7 mm/N(f)	HP 11524A
S-parameter test set	HP 85047A

DESCRIPTION AND PROCEDURE

Perform the *Sampler Diode Bias Adjustment* procedure before continuing.

Figures 20, 21, and 22 each show two different test setups. The setup without an HP 85047A test set is for instruments which do not have option 006. The setup with an HP 85047A test set is for testing option 006 instruments.

Keep cables from the power splitter to the power sensor and to input R as direct as possible, with the smallest amount of loss possible.

If the R sampler is replaced or assigned new correction constants, both A and B samplers must be re-corrected. The setup for the A and B samplers assumes that input R has already been corrected.

Warm-up time: 30 minutes.

1. Make sure the A9 CC jumper is in the ALTER position.

2. Press **[PRESET] [LOCAL]** ***[SYSTEM CONTROLLER]***.

   On the HP 8702 Only:
   Press **[CAL]** ***[DEVICE TYPE] [E/E]***.

   On Option 006 Instruments Only:
   Press **[CAL]** ***[PWRMTR CAL] [LOSS/SENSOR LISTS] [POWER LOSS] [CLEAR LIST] [YES]***.

   This clears the power loss list.

3. Press **[LOCAL]** ***[SET ADDRESSES] [ADDRESS: POWER MTR]***.

   The analyzer will now display the HP-IB address it expects the power meter to be using (the default address is 13). Refer to the power meter manual as required to observe or change its address.

4. Press ***[438A]***. The softkey title will change to ***[436A]***, indicating that the HP 436A power meter is now selected.

   If Using an HP 438A Power Meter:

   The HP 438A has two input channels. Connect the HP 8482A power sensor to HP 438A channel A. If testing above 3 GHz, connect the HP 8481A power sensor to HP 438A channel B.

Power Sensor Calibration Factor Entry

Calibration factor entry procedure from 300 kHz to 3 GHz. The following steps allow you to enter up to twelve calibration factors at desired frequencies up to 3 GHz.

5. Press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [POWER SENSOR]***).

   On the HP 8753B/C or 8702B Only:

   Press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [CAL FACTORSENSORA]***.

6. Press ***[ADD]***

   This adds a frequency/calibration factor entry. Each entry you make is sequentially numbered from 1 to 12. These numbers are called **segment numbers**.

7. Press ***[FREQUENCY]*** **[3] [0] [0] [k/n]**. To enter the first calibration factor frequency.

   NOTE: On subsequent execution of this step, use the next calibration factor frequency and appropriate frequency terminator key.

   If you make a mistake, use the **[BACK SP]** key to backspace over the entered value, then enter the correct value.

8. Press ***[CAL FACTOR]*** **[n] [n] [x1]**.

   Where n is the calibration factor percentage expressed as a whole number.

9. Press ***[DONE]***.

   This completes one entry into the calibration factor table.

   If you notice a mistake after you have pressed the *[DONE]* softkey:

   If your mistake is in the last entry, press ***[EDIT]*** and continue the procedure from step 7.

   If your mistake is in a previous entry, press ***[SEGMENT]*** **[n] [x1]** ***[EDIT]*** (n is the segment number of the incorrect entry) and continue the procedure from step 7.

10. Repeat steps 6 through 9 for each calibration factor up to 3 GHz. If you have finished entering factors up to 3 GHz, proceed with step 11.

11. Press ***[DONE]***.

This completes the calibration factor entry procedure up to 3 GHz.

Calibration factor entry procedure above 3 GHz. The following steps allow you to enter up to twelve calibration factors at desired frequencies from 3 to 6 GHz.

12. Press ***[CAL FACTOR SENSOR B]***.

    Repeat steps 6 through 11 for calibration factors from 3 to 6 GHz.

Updating Sampler Correction Constants

13. Set the power meter to the WATT mode. Zero the power meter. Calibrate the power meter with its built-in power reference.

14. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [3] [x1]**.

15. Press ***[EXECUTE TEST] [YES]***.

    This allows the correction constants to be altered.

16. Connect the test equipment as shown in Figure 19.

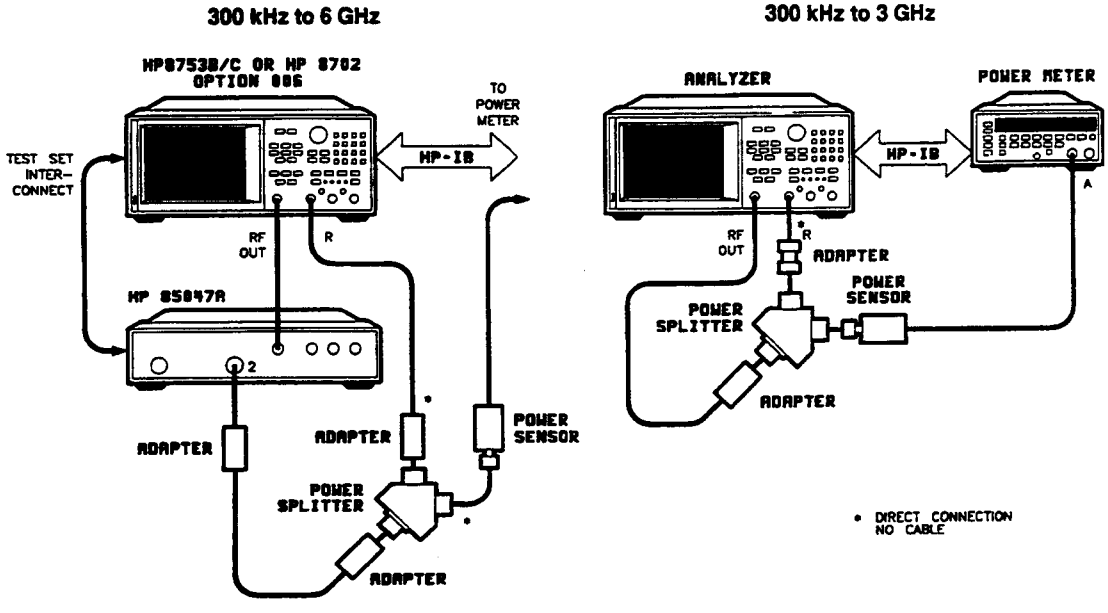


Figure 19. Input R Sampler Correction Setup

17. Press ***[CONTINUE]***.

    This starts the first part of the automatic adjustment procedure. This part will finish after about two minutes.

Option 006 Instruments Only: When the first part of the adjustment is finished, connect the HP 8481A sensor to the power splitter instead of the HP 8482A. If using the HP 436A power meter, turn off the power meter to return it to local control, and then zero and calibrate the meter. If using the HP 438A power meter, the HP 8481A should be connected to input B. Press ***[CONTINUE]***.

18. When the instrument completes the first part of the adjustment, change the equipment setup as shown in Figure 20. Use two cables of equal electrical length at the power splitter outputs.

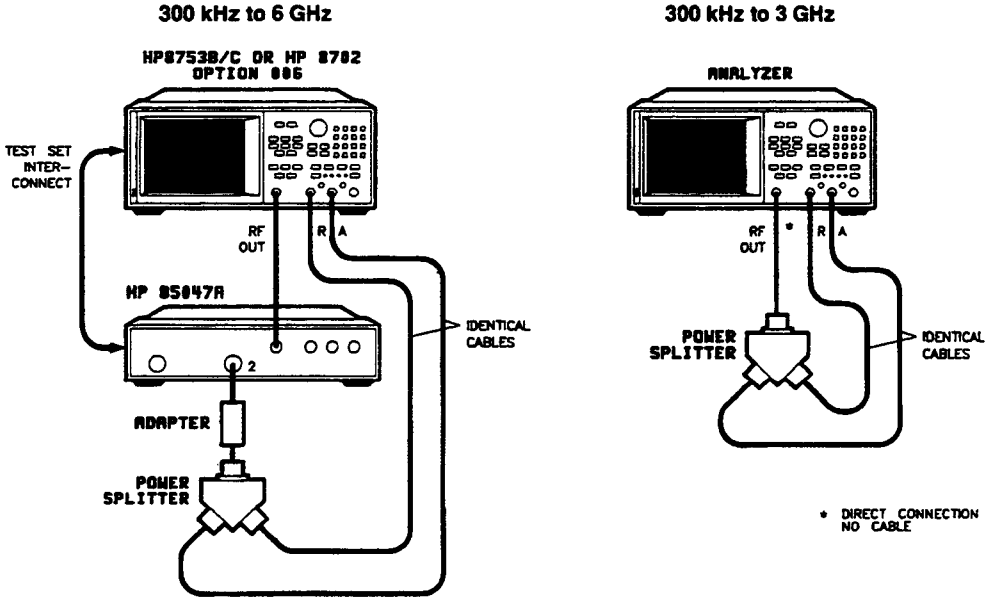


Figure 20. Input A Sampler Correction Constant Setup

19. Press ***[CONTINUE]***.

    This starts the second part of the automatic adjustment procedure.

20. When prompted, move the cable from input A to B as shown in Figure 21.

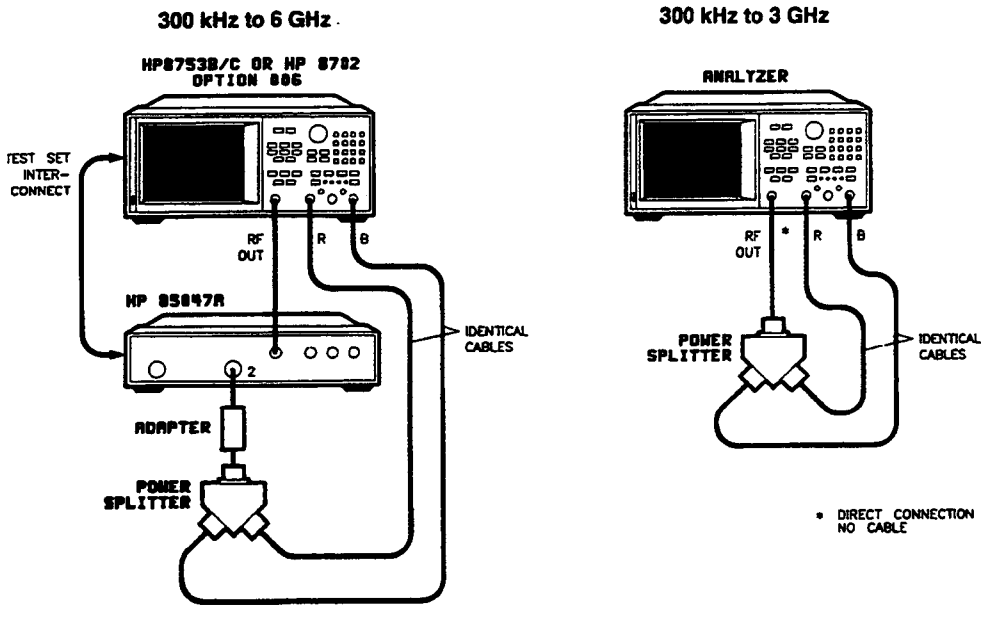


Figure 21. Input B Sampler Correction Constant Setup

21. Press ***[CONTINUE].***

    This starts the final part of the of the automatic adjustment procedure.

22. When the automatic procedure is finished, look at the CRT:

    - If "DONE" is displayed, this procedure is finished. You may store the new correction constants to disk if desired. To do this, refer to the *EEPROM Backup Disk Procedure* (located at the end of this section).

    - If "FAIL" is displayed, repeat the entire procedure again. If "FAIL" is displayed again, refer to *Receiver* for troubleshooting information.

Optional Check Procedure

If you want to see the effect of the sampler correction constant on input R, perform the following steps:

1. Connect a cable directly from RF OUT to input R.

2. Press:

   [PRESET] ***[MEAS] [R]***
   [SCALE REF] ***[SCALE/DIV]*** **[.] [5] [x1]**
   [REFERENCE VALUE] **[0] [x1]**
   [SYSTEM] ***[SERVICE MENU] [SERVICE MODES] [MORE].***

   The display should appear as shown in Figure 22a, below.

3. Press ***[SAMPLR COR ON/off].***

   This turns sampler correction off. The display should appear as shown in Figure 22b, below. If results displayed in step 2 or 3 do not appear correct, rerun the test. If either of them are still incorrect, refer to the *Receiver* troubleshooting section.

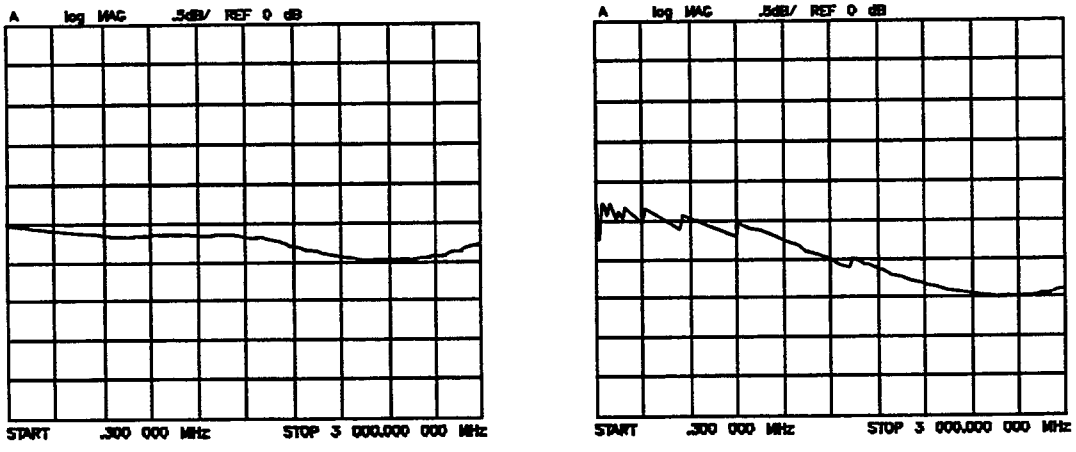


Figure 22. Effect of Sampler Correction Constants

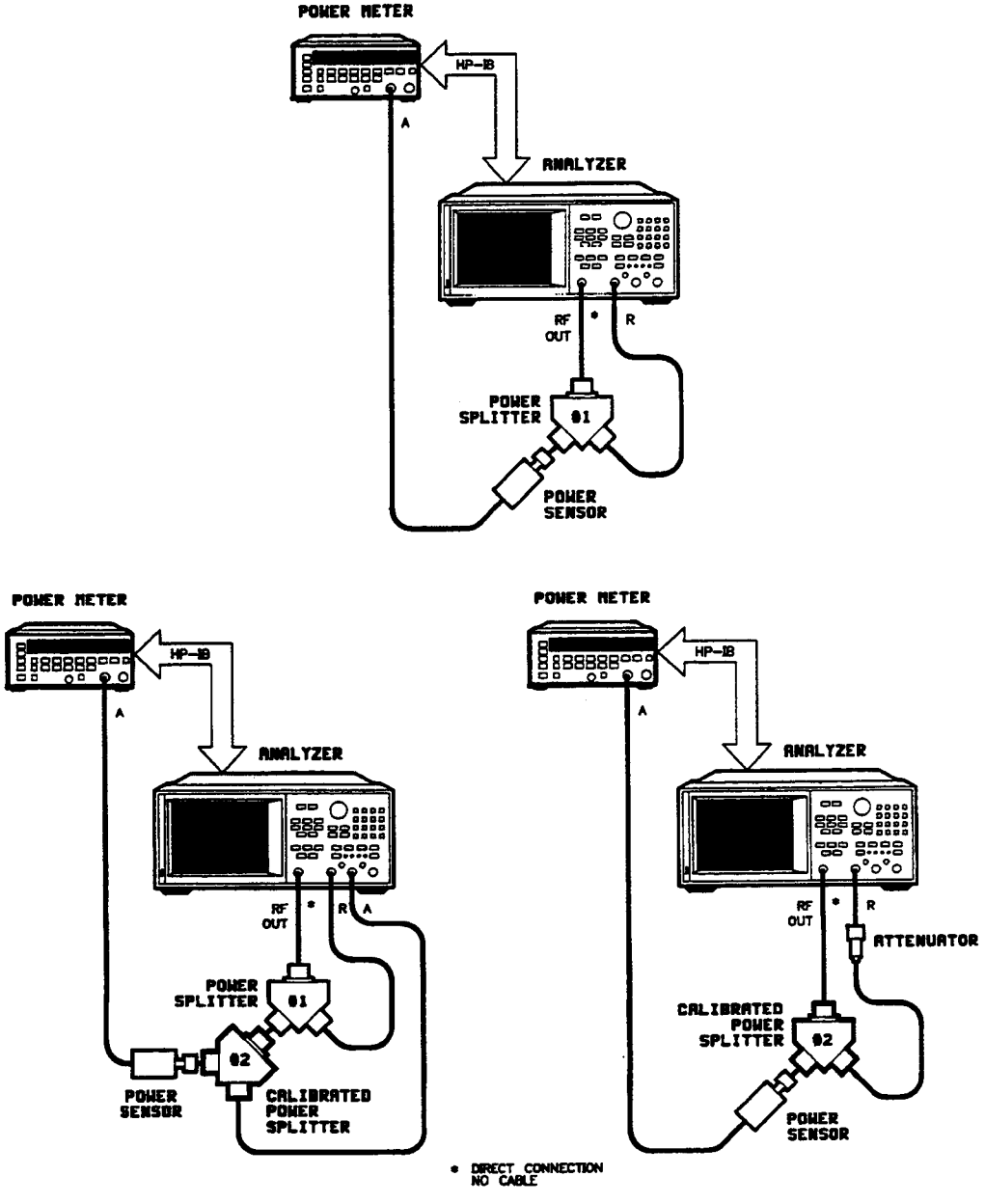


Figure 23. Source Adjustment Setups

EQUIPMENT

Power splitters (2)	HP 11667A option 001
Power meter	HP 436A option 022 or HP 438A
Power sensor	HP 8482A
RF cable set	HP 11851B
20 dB attenuator	HP 8491A option 020

DESCRIPTION AND PROCEDURE

Perform the Sampler Magnitude and Phase Correction Constants before continuing.

Several correction constants improve the output power level accuracy of the internal source. They relate to power level, power slope, power slope offset, and ALC rolloff factors among others. Warm-up time: 30 minutes.

1. Check the A9 CPU board jumper. Press **[PRESET] [MEAS]** ***[R]*** to measure input R.

   HP 8702 ONLY: Press **[CAL]** ***[DEVICE TYPE] [E/E]***.

2. Press **[LOCAL]** ***[SYSTEM CONTROLLER] [SET ADDRESSES] [ADDRESS: POWER MTR]*** to see the address at which the analyzer expects to find the power meter (the default address is 13). Refer to the power meter manual as required to observe or change its address to 13. Press ***[POWER MTR: 438A/437]*** to toggle between 438A/437 and 436A and match your power meter model number. When using the HP 438A, use channel A.

Power Sensor Calibration Factor Entry

3. Press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [CAL FACTOR SENSOR A]*** to access the calibration factor menu (HP 8753A: press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [POWER SENSOR]***).

   NOTE: In this menu you can build a table of up to twelve points (twelve frequencies with their cal factors). Input frequency as GHz or MHz by pressing the appropriate entry key. Input cal factor percentages as whole numbers (for example, enter CAL FACTOR 98% as 98). The cal factor and frequency values are found on the back of the HP 8482A power sensor. The following terms are part of the sensor calibration menu:

   [SEGMENT]: press and use RPG or entry keys to select a point
   [EDIT]: press to change a previously entered value
   [DELETE]: press to delete a point from the table
   [ADD]: press to add a point to the table
   [CLEAR LIST]: press to erase the entire table
   [DONE]: press when a table is complete and correct.

4. Press the appropriate softkeys to build a sensor calibration table.

Power Loss through Power Splitter Determination

5. Zero and calibrate the power meter (refer to its manual as required).

NOTE: Power splitters may have different attenuation at different frequencies. To increase the accuracy of the analyzer, measure the power loss between the input and the output of power splitter #2.

6. Connect the equipment as indicated in Figure 23 (A), using splitter #1.

7. On the analyzer, press **[MENU] [CW FREQ] [3] [0] [0] [k/m]** to generate a CW frequency of 300 kHz. Record the power meter reading in the first column, below.

Setup **A** Reading (First Reading)	Setup **B** Reading (Second Reading)	Power Loss of #2 (Enter in analyzer)
300 kHz: _____dB	minus _____ dB	equals _____ dB
50 MHz: _____dB	minus _____ dB	equals _____ dB
1.5 GHz: _____dB	minus _____ dB	equals _____ dB

8. Repeat the preceding step at 50 MHz and 1.5 GHz.

9. Reconfigure the equipment as shown in Figure 23 (B). Repeat the measurements at the same frequencies and note the power readings in the second column, above.

10. Subtract the second column at each frequency from the first column and enter the difference (a positive number) in the third column.

11. Press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [POWER LOSS]*** and enter the power loss data in the same way you entered the calibration factors.

Source Correction Routine

12. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [7] [x1]** to display "Source Cor" on the CRT.

13. Press ***[EXECUTE TEST]*** and ***[YES]*** at the prompt to alter the correction constants. Connect the equipment as shown in Figure 23 (C) using splitter #2 when prompted.

14. Press ***[CONTINUE]*** to run the test. At the prompt, use the RPG knob to position the marker at the point (or knee) where power begins to roll off more quickly than at lower frequencies. To see the effect of this adjustment, position the marker anywhere on the center line and press ***[CONTINUE]***. You can reposition the marker as many times as required to achieve the flattest line.

    If there is no appreciable roll-off, position the marker at the highest frequency. Press ***[SELECT]*** to select the marker position which most effectively flattens the trace.

15. The test status indicator "DONE" signals the successful conclusion of this routine. The test status indicator "FAIL" is best handled by performing this procedure again. In case of continued failure, refer to *Source* in the troubleshooting section of this manual.

IF Amplifier Correction Constants

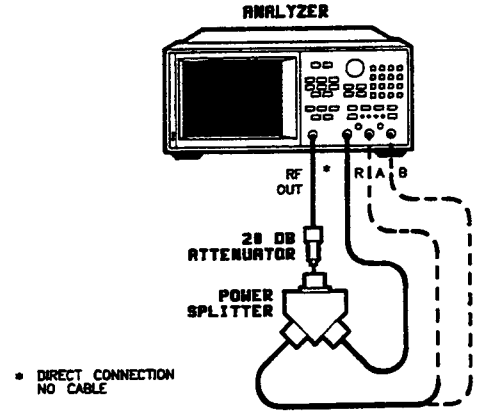


Figure 24. IF Amplifier Correction Constant Setup

EQUIPMENT

RF cable	HP 85131C/D
Power splitter	HP 11667A option 001
Attenuator, 20 dB	HP 8491A option 20

DESCRIPTION AND PROCEDURE

These correction constants compensate for possible discontinuities of signals greater than −30 dBm. Warm-up time: 30 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [1] [x1]** and then press ***[EXECUTE TEST]*** when "IF Step Cor" appears. Press ***[YES]*** at the query to alter the correction constants.

2. At the prompt, connect the attenuator, power splitter and RF cables to inputs R and A as shown in Figure 24. Press ***[CONTINUE]***.

3. At the prompt, connect the attenuator, power splitter and RF cables to inputs R and B as shown in Figure 24. Press ***[CONTINUE]***.

4. If the procedure does not end with "DONE", check the A9 CC jumper and the setup and repeat. In case of difficulty, refer to *Digital Control*.

Cavity Oscillator Frequency Correction Constants

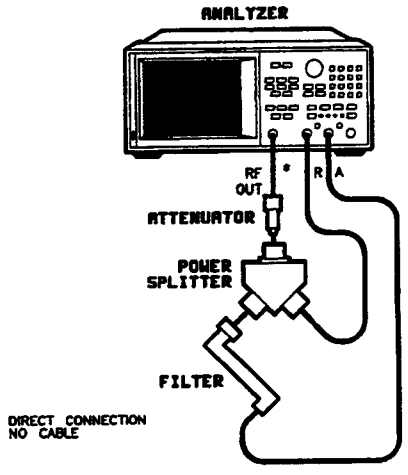


Figure 25. Cavity Oscillator Frequency Correction Constant Setup

EQUIPMENT

Attenuator (20 dB)	HP 8491A option 020
Power splitter	HP 11667A option 001
Low-pass filter	HP 360B/C (fc = 1.2/2.2 GHz)
RF cable set	HP 11851B

DESCRIPTION AND PROCEDURE

The nominal frequency of the cavity oscillator is 2.982 GHz, but it varies with temperature. This procedure determines the precise frequency of the cavity oscillator at a particular temperature by identifying a known spur.

NOTE: This procedure *should* be performed with one of the recommended filters or a filter with at least 50 dB rejection at 2.9 GHz and a passband which includes 800 MHz. The filter makes spur identification substantially faster and more reliable.

With the filter, the operator need distinguish between only two spurs, each of which should be 10 dB to 20 dB (3 to 4 divisions) above the trace noise.

Without the filter, the target spur is one of four or five spurs, each of which may be 0.002 to 0.010 dB (invisible to 2 divisions) **above or below** the trace noise.

Perform the first five steps of the procedure at least once for familiarization before trying to select the target spur (especially if you lack a filter or prior experience).

1. Check the A9 CC jumper. Connect the equipment as shown in Figure 25, and turn on the analyzer. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [4] [x1]**.

2. When the CRT displays "Cav Osc Cor", press ***[EXECUTE TEST]***. Then press ***[YES]*** at the query to alter the correction constants.

   NOTE: During this adjustment routine, you will see several softkeys:

   [CONTINUE] sweeps the current frequency span; may be pressed repeatedly for additional looks at the current frequency span.

   [NEXT] sweeps the next (2 MHz higher) frequency span.

   [SELECT] enters the value of the marker (which should be on the spur) and exits the routine.

   [ABORT] exits the routine.

3. Press ***[CONTINUE]*** to sweep the first frequency span three times. Note that each new span overlaps the previous span by 3 MHz (the center frequency increases by 2 MHz; the span is 5 MHz). Thus anything visible on the right half of the CRT on one set of sweeps will appear on the left half or center of the CRT when ***[NEXT]*** is pressed.

4. Press ***[NEXT]*** repeatedly. Watch the trace on each sweep and try to spot the target spur. With the filter, the target spur will be one of two obvious spurs (see Figure 24). Without the filter (not recommended), it will be one of four or five less distinct spurs as shown in Figures 27, 28, and 29. When the center frequency increases to 2994.999 MHz, "Cav Osc Cor FAIL" will appear on the display.

5. If you think you spotted the target spur, continue with step 6 (filter procedure) or step 8 (filterless procedure). Otherwise repeat steps 2 through 5.

Spur Search Procedure with Filter

6. Press ***[EXECUTE TEST] [YES] [CONTINUE]*** and the other softkeys as required to observe and mark the target spur. With the filter, the target spur will appear to the right of a second spur, similar to Figure 26.

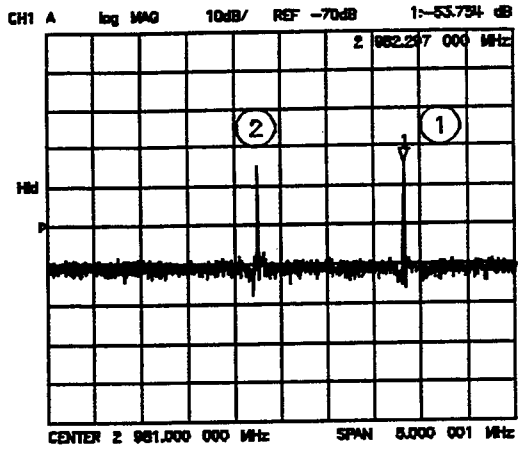


Figure 26. Target Spur is on Right in Typical Display of Spurs with Filter

7. Rotate the RPG knob to position the marker on the spur and then press ***[SELECT]***. Observe the CRT:

   - "DONE" appears: the procedure has been performed successfully. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.

   - "CORRECTION CONSTANTS NOT STORED" appears: check the position of the A9 CC jumper. Repeat the procedure. In case of continuing difficulty, refer to the *Troubleshooting* section.

Spur Search Procedure without Filter

8. Press ***[EXECUTE TEST] [YES] [CONTINUE]*** and the other softkeys as required to observe and mark the target spur.

9. Without the filter, the target spur will appear in a variety of disguises. Often it will be difficult to identity positively; occasionally it will be nearly impossible to identify. Do not hesitate to press ***[CONTINUE]*** as many times as necessary to thoroughly inspect the current span.

   Without the filter, the target spur usually appears as one of a group of **four evenly spaced** spurs, as in Figure 27. The target spur is the right-most spur (fourth from the left). On any particular sweep one, any or all of the spurs may be large, small, visible, invisible, above or below the reference line.

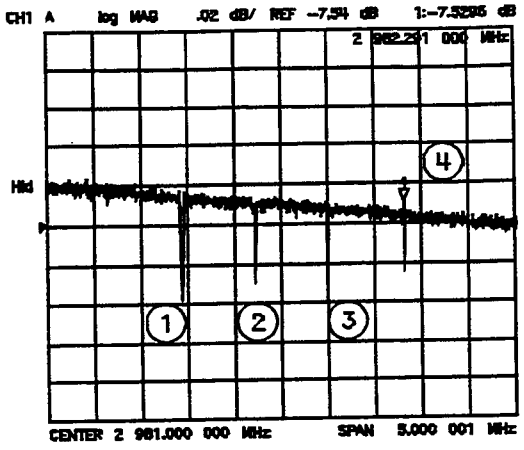


Figure 27. Target Spur is Fourth from Left in Typical Display of Four Spurs without Filter

On occasion the target spur appears as one of a group of **five evenly spaced** spurs, as in Figure 28. The target spur is again the fourth from the left (not the fifth, right-most spur).

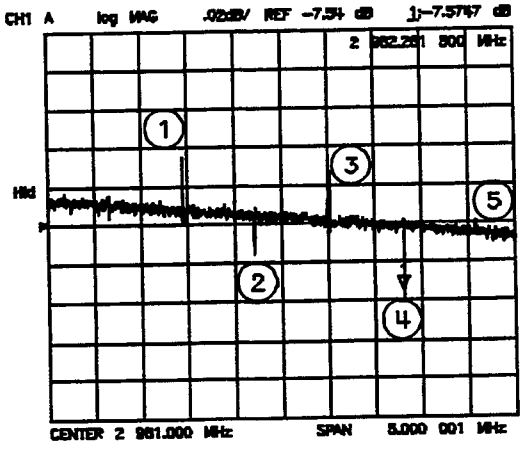


Figure 28. Target Spur is Fourth from Left in Typical Display of Five Spurs without Filter

Figure 29 shows another variation of the basic four spur pattern: some up, some down and the target spur itself almost indistinguishable.

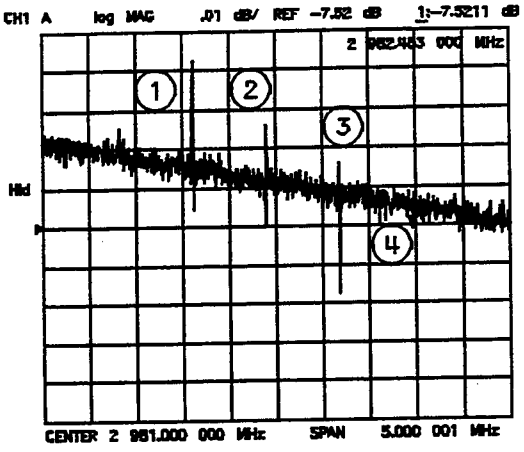


Figure 29. Target Spur is Fourth from Left, almost invisible, in Variation of Display of Four Spurs without Filter

10. Rotate the RPG knob to position the marker on the target spur. Then press ***[SELECT]*** and observe the CRT:

    - "DONE" appears: the procedure has been performed successfully. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants.
    - "CORRECTION CONSTANTS NOT STORED" appears: check the position of the A9 CC jumper. Repeat the procedure. In case of continuing difficulty, refer to the *Troubleshooting* section.

Cal Kit Default Correction Constants

DESCRIPTION AND PROCEDURE

This internal adjustment test writes default calibration kit definitions (device model coefficients) into EEPROM.

1. Check that the A9 CC jumper is in the ALTER position.

2. Press **[PRESET]** ***[SYSTEM] [SERVICE MENU] [TESTS]*** **[57] [x1]**. When the CRT displays "Cal Kit Def-ND-", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constants.

3. When complete, observe the CRT:

   - "DONE" displayed: the adjustment is done. Refer to the EEPROM Backup Disk Procedure to store the new correction constants. Return the A9 CC jumper to the NORMAL position.

   - "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to A9 CC Jumper Position to reposition the jumper; repeat the procedure.

   - "FAIL" displayed: Carefully repeat the procedure. If the procedure continues to fail, contact HP.

EEPROM Backup Disk Procedure

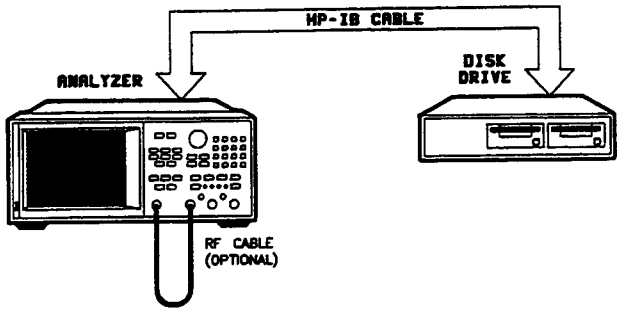


Figure 30. EEPROM Backup Procedure Setup

EQUIPMENT

CS80 disk drive	HP 9122
HP-IB cable	HP 10833A/B/C/D
3.5" microfloppy disk	HP 92192A (box of 10) or disk supplied with instrument

DESCRIPTION AND PROCEDURE

Correction constants are stored in EEPROM on the A9 assembly. The great value of the EEPROM backup disk is its capability to store all of the correction constant data to a new or repaired A9 assembly without having to rerun the correction constant procedures. HP 8753B/C and 8702 instruments are shipped from the factory with an EEPROM correction constant backup disk which is unique to each instrument.

- Make an EEPROM backup disk and keep it current.
- Store the correction constant data to the EEPROM backup disk each time a correction constant routine is performed.
- Retrieve correction constant data from the EEPROM backup disk if the A9 assembly is replaced.

This data can be updated or retrieved using the following procedures.

How to Make an EEPROM Backup Disk and Store Correction Constant Data to It

1. Connect the instruments as shown in Figure 30 and turn them on. Make sure the drive is set to HP-IB address 00. Then press **[LOCAL]** ***[SYSTEM CONTROLLER]***.

2. If the disk is not initialized, press **[SAVE]** ***[STORE TO DISK] [DEFINE STORE] [INITIALIZE DISK] [INIT DISK? YES]***.

3. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [MORE] [STORE EEPR ON]*** to store the EEPROM data with the instrument state.

4. Press **[SAVE]** ***[STORE TO DISK] [TITLE FILES] [TITLE FILEn] [ERASE TITLE]*** and then use the RPG and softkeys to title the file "N12345" (the first character must be a letter; 12345 represent the last five digits of the instrument's serial number).

   When finished, press ***[DONE] [RETURN] [STORE N12345]***.

5. Label the disk with the serial number of the instrument and the words "EEPROM Backup Disk."

6. When all correction constant adjustments are complete, return the A9 CC jumper to NORMAL position.

How to Retrieve Correction Constant Data from the EEPROM Backup Disk

1. Connect the instruments as shown in Figure 30. Make sure the drive is set to HP-IB address 00.

2. Make sure the A9 CC jumper is in the ALTER position. Install the new A9 assembly.

3. Turn on the instruments. If the analyzer display requires intensity or focus adjustment, perform those adjustments now.

NOTE: Disregard noisy trace data or error messages on the display now.

4. Press **[LOCAL]** ***[SYSTEM CONTROLLER]*** **[RECALL]** ***[LOAD FROM DISK] [READ FILE TITLES] [LOAD N12345]*** where N12345 represents the file name of the EEPROM data for the analyzer. On the factory-shipped EEPROM backup disk, the file name is FILE1.

5. Perform the serial number and, if applicable, the option number correction constant routines.

6. Press **[PRESET]** and verify that good data was transferred to EEPROM by performing a simple measurement.

7. In case of difficulty, refer to *Troubleshooting*.

REPAIR SEQUENCE

Troubleshooting: identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

The troubleshooting strategy of this manual is based on a verification (rather than symptomatic) approach. This section's first step is to verify the operation of the analyzer alone, independent of accessories or system peripherals. Accessories are devices like test sets, light wave modules, power probes, power splitters, cables, calibration and verification kits. Peripherals are devices like computers, disk drives, plotters, for instance, and typically use HP-IB and line current. This section also suggests remedies for system problems external to the analyzer.

Isolate Faulty Group, the next section, assumes that the fault is within one of the instrument's five functional groups: power supply, digital control, source, receiver and accessories. *Isolate Faulty Group* (*IFG*) identifies the group and refers the technician to the appropriate section. These first sections, *Troubleshooting* and *Isolate Faulty Group*, stress simple, straight forward procedures.

Each of the five sections following *IFG* verifies, one at a time, the assemblies within a group until the faulty assembly is identified. These five sections employ more lengthy, complicated procedures.

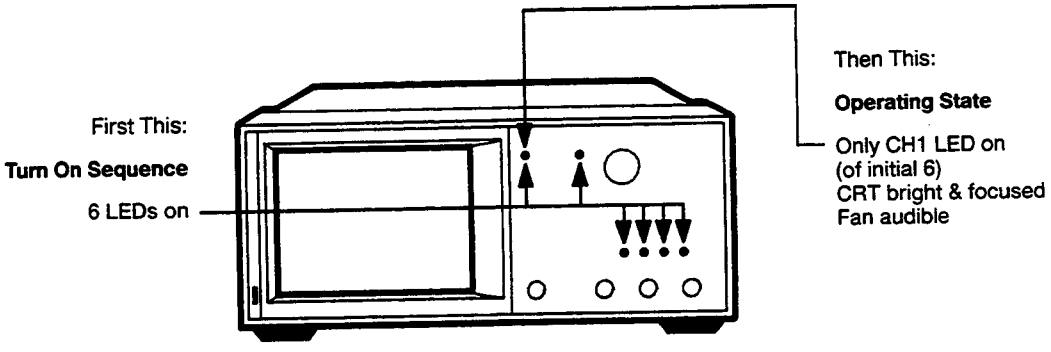
Post-Repair Procedures (*PRP*), is the last section of the troubleshooting portion of the manual. *PRP* is organized by assembly and notes what adjustment to perform and how to verify proper instrument operation following the replacement of an assembly.

INITIAL OBSERVATIONS

A system failure can be caused by a problem in the analyzer and its accessories or out of the analyzer (in a peripheral or programming). If the failure is obviously in the analyzer or its accessories, go directly to the *Isolate Faulty Group* section.

Otherwise, disconnect everything from the analyzer: all test set interconnect, HP-IB, probe power and RF cables. Plug in the analyzer and connect one cable from RF OUT to input R.

Turn on the analyzer and watch for the following in this order:



In case of unexpected results, check AC line power to the instrument. Check the fuse (rating listed on rear panel, spare inside holder). Check the line voltage setting (use small screwdriver to change). If the problem persists, refer to *Isolate Faulty Group*.

OPERATOR'S CHECK

The *Operator's Check* verifies with 80% confidence that the analyzer is functioning properly. This is an excellent test to begin troubleshooting measurement problems.

NOTE: To troubleshoot lightwave measurement problems, see *Lightwave Troubleshooting.*

Equipment

20 dB attenuator	HP 8491A option 020
RF cable set	HP 11851B
Two-way power splitter	HP 11667A option 001

Procedure

1. Turn on the analyzer for a 30 minute warm-up.

2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[2] [1] [x1]**. When "TEST 21 R&A Op Check" appears on the CRT, press ***[EXECUTE TEST]***.

3. At the prompt, connect the equipment as shown in Figure 1, with power to inputs R and A. Press ***[CONTINUE]*** as prompted until the CRT displays PASS or FAIL.

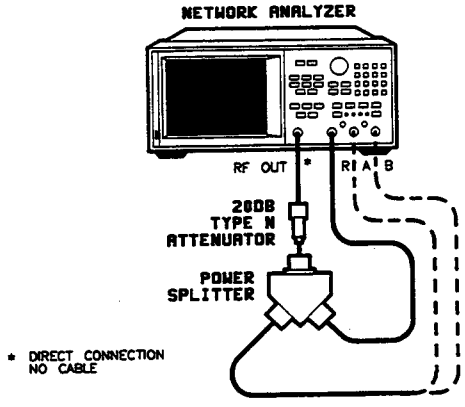


Figure 1. Operator's Check Setup

4. Press **[2] [2] [x1]** to access the input R and B operator's check. When the title appears, press ***[EXECUTE TEST]***. Move the RF cable from input A to B. Press ***[CONTINUE]*** as prompted until the CRT displays PASS or FAIL.

5. If one or both tests fail:

   - Recheck the equipment configuration and connections; if necessary, retest.
   - Confirm that the attenuator, splitter and cables meet their published specifications. Visually inspect the connectors. Retest or refer to *Isolate Faulty Group* as indicated.

   If both tests pass:

   - Reconnect any accessory (test set, lightwave modules, power splitter, cables, etc) normally in the system. Refer to its manual to perform the operator's check or inspection procedure. With HP 85046A/B or 85047A test sets, remember to connect the test set interconnect cable. Use the device's manual to troubleshoot any problems.

6. If the analyzer uses HP-IB, continue with the next paragraph. If the analyzer does NOT use HP-IB, duplicate the operating conditions under which the system failed and refer to *Isolate Faulty Group* if the problem reappears.

LIGHTWAVE TROUBLESHOOTING (only for HP 8702 systems using HP 83410A Lightwave Receivers and HP 83400A/401A Lightwave Sources)

HP 8702 Stand-Alone Check

NO Lightwave Accessories Attached

This test will check the HP 8702 in stand-alone (electrical only) operation. It will verify that the analyzer's RF source is working (flatness) and that the HP 8702 is properly making B/R ratio measurements over the 300 kHz to 3 GHz band. It will also check the RF Interface Kit (splitter, 20 dB pad, and RF cables) by verifying that it is not causing a problem.

Procedure

Disconnect all lightwave accessories: Lightwave Source and Lightwave Receiver, but leave the RF Interface Kit connected as shown below:

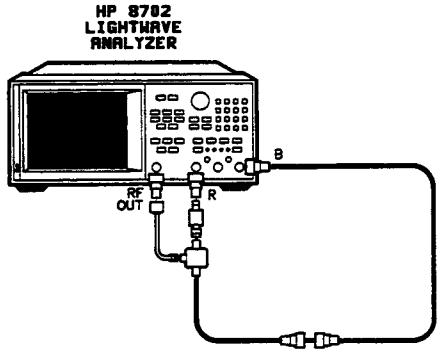


Figure 2. HP 8702 Stand-Alone Test Setup

1. Turn on the HP 8702, press **[PRESET]**. The CRT display should show an A/R measurement of noise: a ratio of the open port of receiver input A divided by the power (0 dBm) input to reference R.

2. Make a *thru* connection between the RF output and the B input. This is the same as an E/E transmission measurement. Then press:

   [MEAS] ***[B/R]*** and **[CAL]** ***[DEVICE TYPE] [E/E]***
   [SCALE REF] ***[SCALE/DIV]*** **[[1] [x1].**

   The result should be similar to the plot shown in figure 3: a flat line at about 20 dB.

   Assume B/R =1 (without RF Interface Kit),

   RF Power Out =0 dBm (Preset). Power Splitter loss =6 dB for R and B inputs so the ratio remains unchanged. 20 dB Attenuator at R input changes the ratio from 1 to 20 where B input power is 20 times greater than R, regardless of the input power.

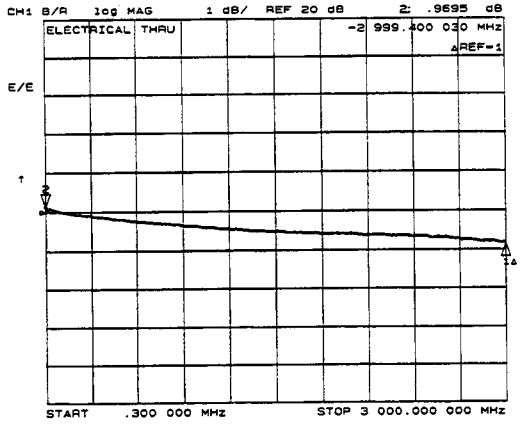


Figure 3. Electrical Measurement Check: B/R ratio =20 dB and RF Flatness <1dB.

3. Inspect the RF Source Flatness and the RF cables. With the Scale/Div value at 1 dB and the Reference Value at about 20 dB, verify that the RF Source trace is within 1 dB as it rolls off steadily over the full band.

   Move the RF cables around to verify that they are not causing any attenuation. Check RF each connection point (splitter, attenuator, cables) to be sure they are stable and not causing any problems.

   To further verify the RF source flatness, press:

   STIMULUS [MENU] and ***[POWER]***. Adjust the power level from −10 dBm to +20 dBm and verify that the trace remains flat within 1 dB.

4. Check the dB power conversion. Press:

   [CAL] ***[DEVICE TYPE] [O/O]***.

   Notice that the trace moves from 20 dB to 10 dB. Check that [E/O], [O/E], and [E/E] all show the same value. But [O/O] device types show a 10 dB difference.

   The difference is due to the way the HP Lightwave Receiver detects power and the way the HP 8702 calculates the measurement. In the O/O case, the HP 8702 knows that it is measuring a strictly optical device and adjusts its power calculation for this measurement.

   In general, optical power and electrical power have the same wattage value and are calculated the same: 10 log $power_1/power_2$,. However, the analyzer measures power as voltage: 20 log $voltage_1/voltage_2$ and this is why there is a difference when it measuring O/O. In general, dB (electrical) =2 x dB (optical).

Results

If the results agree with those shown in the plot, it indicates that the RF Interface Kit is working and that the RF cables and connectors are properly working. It also means that the HP 8702 B and R inputs are receiving and processing the correct signal levels. Also, the RF source is probably working correctly.

In case of difficulty, refer to *Lightwave System Verification* in the *On-Site Verification* section or refer to the lightwave source and receiver manuals.

TROUBLESHOOTING HP-IB SYSTEMS

Check the analyzer's HP-IB functions with a known working passive peripheral (like a plotter or printer or disk drive). Connect the peripheral via a good HP-IB cable to the analyzer. Press **[LOCAL]** ***[SYSTEM CONTROLLER]*** to enable the analyzer to control the peripheral. Then press ***[SET ADDRESSES]*** and the softkeys to see the device addresses recognized by the analyzer. The factory default addresses are:

Device	**HP-IB Address**
8753/8702	16
Plotter	5
Printer	1
Disk (drive)	0
Controller	21
Power meter/HP-IB	13

Other addresses may be used with two provisions: (1) each device must have its own address and (2) the address set on each device must match the one recognized by the analyzer (and displayed on the CRT). Peripheral addresses are often set with a rear panel switch. Refer to the manual of the peripheral to read or change its address.

If Using a Plotter or Printer. Make sure it has power, pens, paper, pinch wheels down, and so forth. Plotters should not be in VIEW mode; some plotters need to have P1 and P2 positions set. Press **[COPY]** and then ***[PLOT]*** or ***[PRINT]***.

If the result is a copy of the CRT display, HP-IB is functional in the analyzer. Continue with *Troubleshooting Systems with Multiple Peripherals*, *Troubleshooting Systems with Controllers*, or the *Isolate Faulty Group* section.

If the result is not a copy of the CRT display, suspect HP-IB problems in the analyzer: refer to the *Digital Control* section.

If Using a Disk Drive. Make sure the drive has power, an initialized disk in the *correct* drive, and the proper disk unit number and volume number (press **[LOCAL]** to see; default is 0, 0.) With hard disk (Winchester) drives, make sure the configuration switch is properly set (see drive manual).

Press **[START]** **[1]** **[M/u]** **[SAVE]** ***[STORE TO DISK]*** ***[STORE FILE 1]***. Then press **[PRESET]** **[RECALL]** ***[LOAD FROM DISK]*** ***[LOAD FILE 1]***. If the resultant trace starts at 1 MHz, HP-IB is functional in the analyzer. Continue with *Troubleshooting Systems with Multiple Peripherals*, *Troubleshooting Systems with Controllers*, or the *Isolate Faulty Group* section.

If the resultant trace does not start at 1 MHz, suspect HP-IB problems in the analyzer: refer to the *Digital Control* section.

Troubleshooting Systems with Multiple Peripherals

Connect any other system peripherals (but not a controller) one at a time and check their functionality. Any problems observed are in the peripherals or HP-IB cables, or are HP-IB address problems (see above).

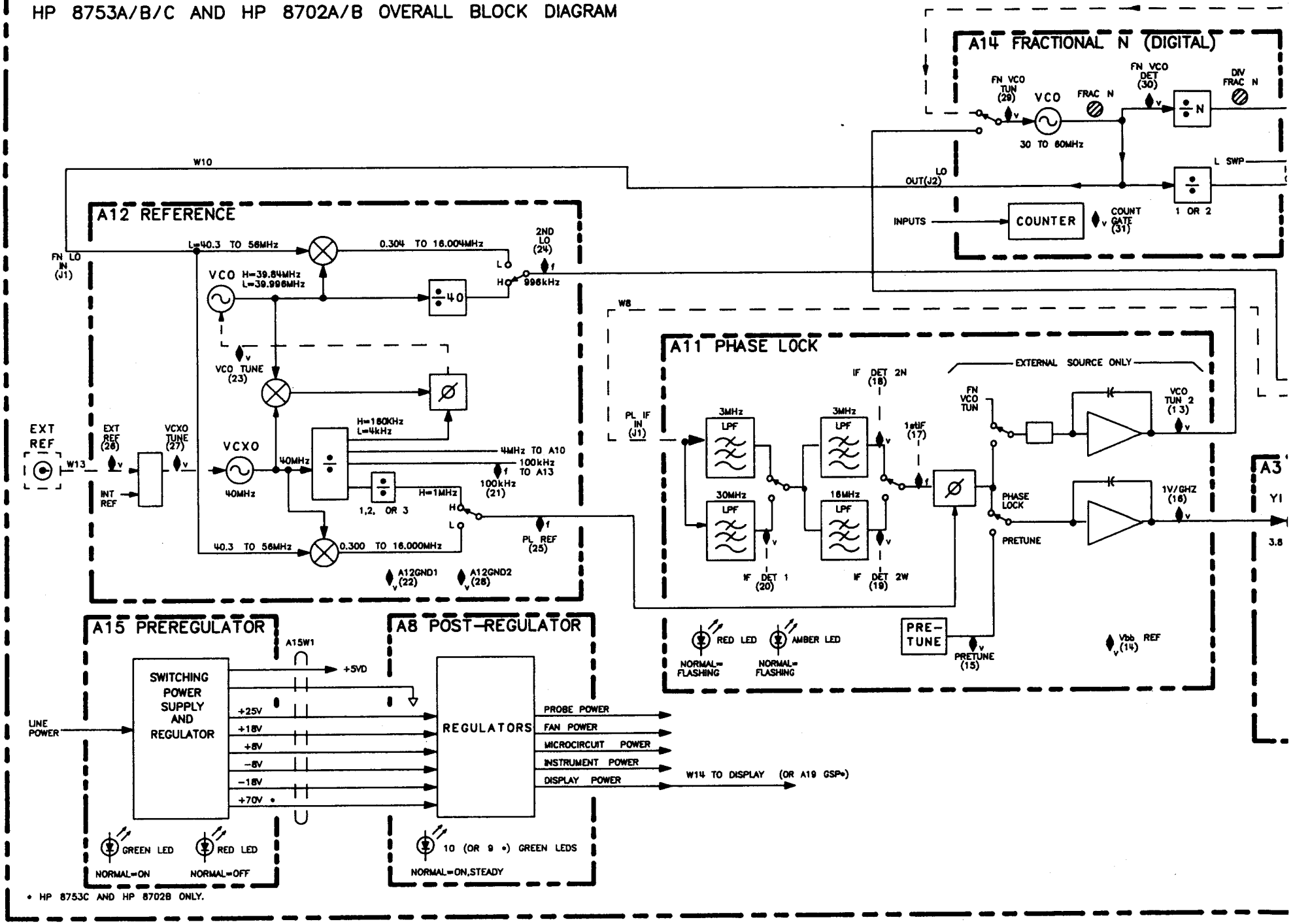
Troubleshooting Systems with Controllers

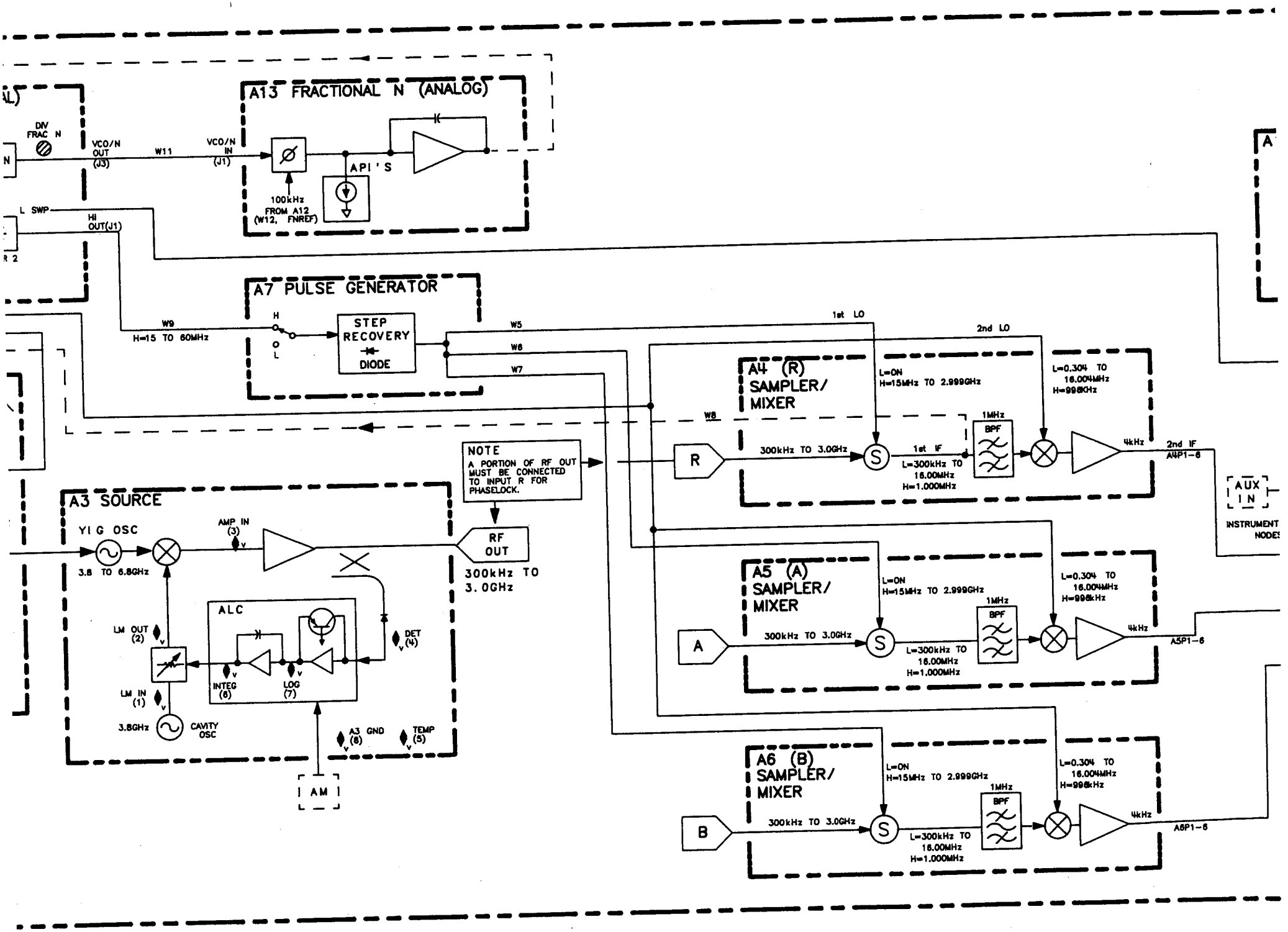
Passing the preceding checks indicates that the analyzer's HP-IB functions are normal. Therefore, if the analyzer has not been operating properly with an external controller, suspect the controller. Check the following:

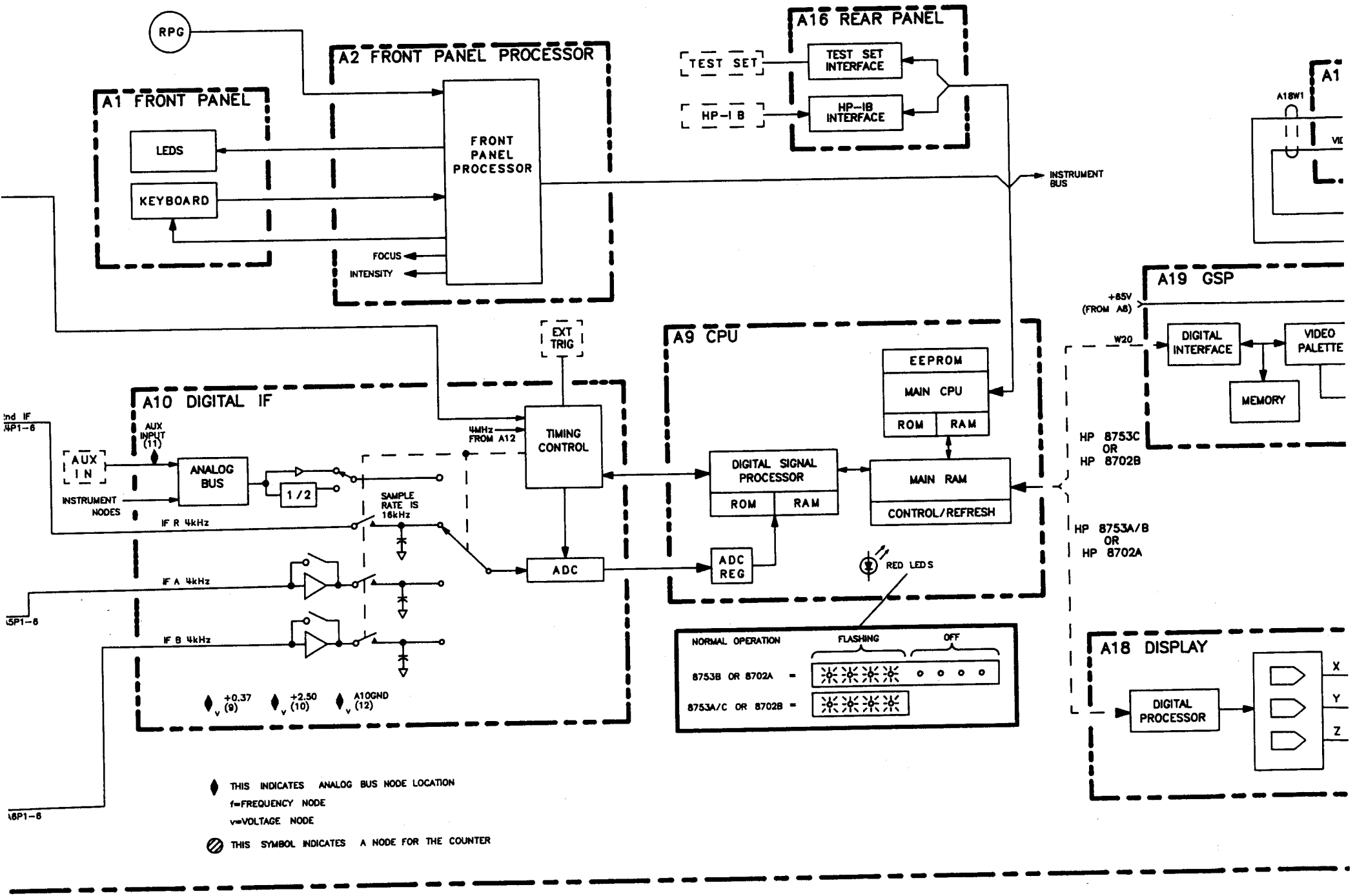
- Compatibility, must be HP 9000 series 200/300, see *System Overview.*
- HP-IB interface hardware must be installed, see *BASIC User's Manual*.
- Select code, see *BASIC User's Manual*.
- I/O and HP-IB binaries loaded, see *BASIC User's Manual*.
- HP-IB cables, see limits in *System Installation*.
- Programming syntax, see the *HP-IB Quick Reference*.

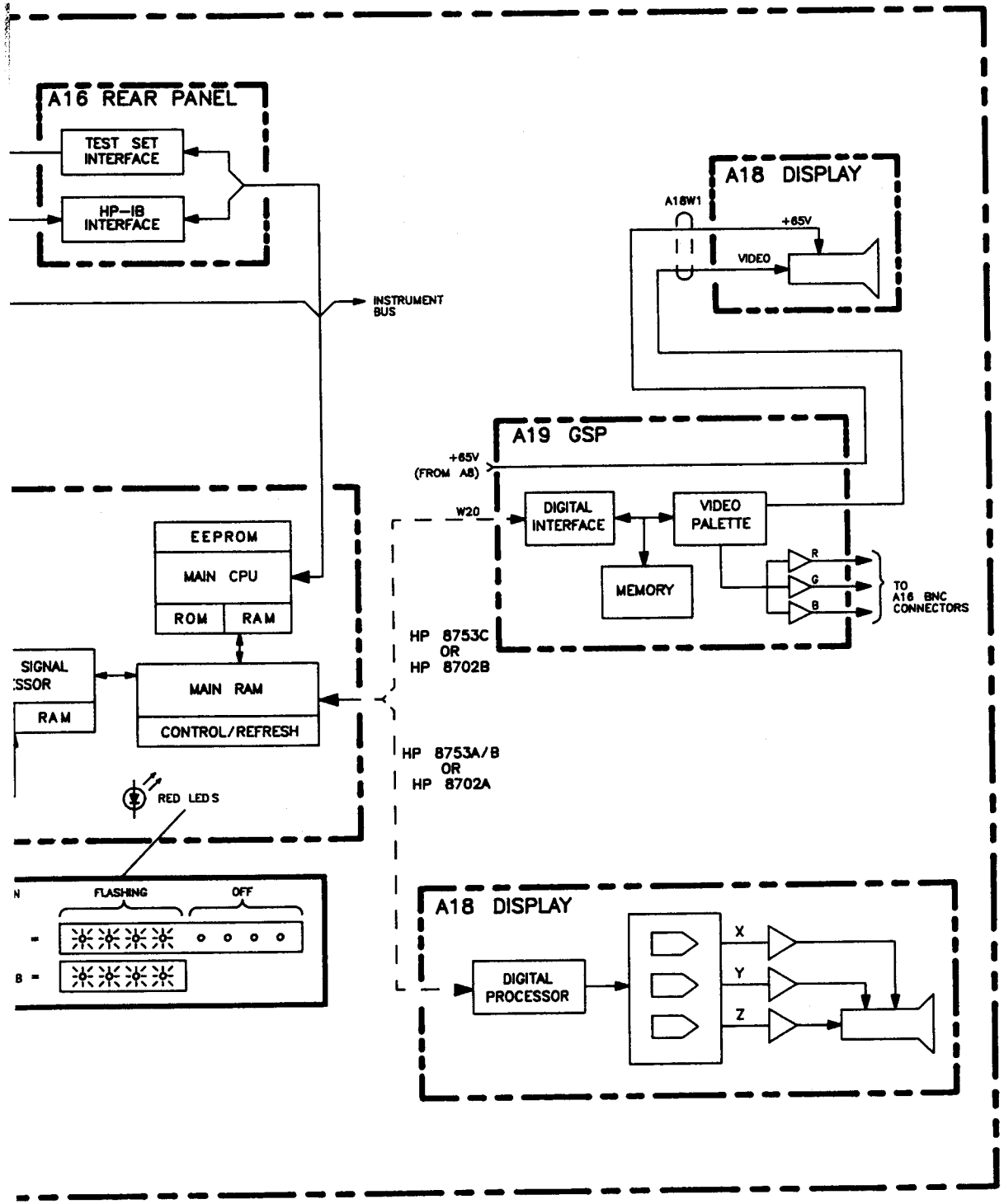
If the analyzer appears to be operating unexpectedly but has not completely failed, go to the *Isolate Faulty Group* section.

HP 8753A/B/C AND HP 8702A/B OVERALL BLOCK DIAGRAM




A13 FRACTIONAL N (ANALOG)
DIV FRAC N
VCO/N OUT (J3)
W11
VCO/N IN (J1)
API'S
100kHz FROM A12 (W12, FNREF)
L SWP
HI OUT(J1)
A7 PULSE GENERATOR
W9
H=15 TO 60MHz
H
L
STEP RECOVERY DIODE
W5
W6
W7
1st LO
2nd LO
A4 (R) SAMPLER/ MIXER
L=ON H=15MHz TO 2.999GHz
L=0.304 TO 16.004MHz H=996KHz
W8
R
300kHz TO 3.0GHz
S
1st IF L=300kHz TO 16.00MHz H=1.000MHz
1MHz BPF
4kHz
2nd IF A4P1-6
NOTE
A PORTION OF RF OUT MUST BE CONNECTED TO INPUT R FOR PHASELOCK.
AUX IN
INSTRUMENT NODE
A3 SOURCE
YIG OSC
3.8 TO 6.8GHz
AMP IN (3)
RF OUT
300kHz TO 3.0GHz
ALC
LM OUT (2)
LM IN (1)
3.8GHz
CAVITY OSC
INTEG (6)
LOG (7)
DET (4)
A3 GND (8)
TEMP (5)
AM
A5 (A) SAMPLER/ MIXER
A
A5P1-6
A6 (B) SAMPLER/ MIXER
B
A6P1-6


RPG
A2 FRONT PANEL PROCESSOR
A1 FRONT PANEL
LEDS
KEYBOARD
FRONT PANEL PROCESSOR
FOCUS
INTENSITY
A16 REAR PANEL
TEST SET
TEST SET INTERFACE
HP-IB
HP-IB INTERFACE
INSTRUMENT BUS
A1
A18W1
A19 GSP
+65V (FROM A8)
W20
DIGITAL INTERFACE
VIDEO PALETTE
MEMORY
EXT TRIG
A9 CPU
EEPROM
MAIN CPU
ROM
RAM
HP 8753C OR HP 8702B
A10 DIGITAL IF
AUX INPUT (11)
AUX IN
INSTRUMENT NODES
ANALOG BUS
1/2
4MHz FROM A12
TIMING CONTROL
SAMPLE RATE IS 16kHz
IF R 4kHz
IF A 4kHz
IF B 4kHz
ADC
DIGITAL SIGNAL PROCESSOR
ROM
RAM
MAIN RAM
CONTROL/REFRESH
ADC REG
HP 8753A/B OR HP 8702A
RED LEDS
NORMAL OPERATION
FLASHING
OFF
8753B OR 8702A =
8753A/C OR 8702B =
A18 DISPLAY
DIGITAL PROCESSOR
X
Y
Z
+0.37 (9)
+2.50 (10)
A10GND (12)
THIS INDICATES ANALOG BUS NODE LOCATION
f=FREQUENCY NODE
v=VOLTAGE NODE
THIS SYMBOL INDICATES A NODE FOR THE COUNTER


A16 REAR PANEL
TEST SET INTERFACE
HP-IB INTERFACE
INSTRUMENT BUS
A18 DISPLAY
A18W1
+65V
VIDEO
A19 GSP
+65V (FROM A8)
W20
DIGITAL INTERFACE
VIDEO PALETTE
MEMORY
R
G
B
TO A16 BNC CONNECTORS
EEPROM
MAIN CPU
ROM
RAM
SIGNAL
SSOR
RAM
MAIN RAM
CONTROL/REFRESH
HP 8753C
OR
HP 8702B
HP 8753A/B
OR
HP 8702A
RED LEDS
FLASHING
OFF
A18 DISPLAY
DIGITAL PROCESSOR
X
Y
Z

WIRING LIST

MNEMONIC	SOURCE	MNEMONIC DESCRIPTION	A1/A2 FRONT PANEL	A3 SOURCE	A4 R SAMPLER/ MIXER	A5 A SAMPLER/ MIXER	A6 B SAMPLER/ MIXER	A7 PULSE GEN	A8 POST- REGULATOR		
			J1	XA3J1	XA4J1	XA5J1	XA6J1	XA7J1	XA8J1	XA8J2	XA9J1
ABUS		ANALOG BUS (ABUS)		31							
ABUSA0	A10P1-21	ABUS ADDRESS 0 (LSB)		11							
ABUSA1	A10P1-51	ABUS ADDRESS 1		30							
ABUSA2	A10P1-22	ABUS ADDRESS 2 (MSB)		10							
ABUSENREF	A10P1-52	ABUS ENABLE REFERENCE									
ABUSENSRC	A10P1-53	ABUS ENABLE SOURCE		29							
L ABUSGATE	A10P2-18	L=ABUS COUNTER GATE									
A HB/LB	A10P2-36	A SAMPLER HB/LB SELECT				8					
B HB/LB	A10P2-1	B SAMPLER HB/LB SELECT					8				
AUX IN	A16P1-8	AUXILIARY INPUT (FROM REAR PANEL)									
L CMOS	A8P1-17, 47	CMOS MEMORY CONTROL (SUPERCAP)							17, 47		44
DIFCC	A10P2-33	DIGITAL IF CONVERSION COMPLETE									
DIFCLK	A10P2-4	DIGITAL IF (SERIAL) CLOCK									
DIF DATA	A10P2-3	DIGITAL IF (SERIAL) DATA (OUT)									
DIFD0	A9P2-27	DIGITAL IF DATA 0 (LSB)									
DIFD1	A9P2-57	DIGITAL IF DATA 1									
DIFD2	A9P2-28	DIGITAL IF DATA 2									
DIFD3	A9P2-58	DIGITAL IF DATA 3									
DIFD4	A9P2-29	DIGITAL IF DATA 4									
DIFD5	A9P2-59	DIGITAL IF DATA 5									
DIFD6	A9P2-30	DIGITAL IF DATA 6									
DIFD7	A9P2-60	DIGITAL IF DATA 7 (MSB)									
L DIFEN0	A9P2-34	DIGITAL IF ENABLE 0									
L DIFEN1	A9P2-5	DIGITAL IF ENABLE 1									
L DIFEN2	A9P2-35	DIGITAL IF ENABLE 2									
DITH	A3P1-22	SOURCE SPUR CONTROL		22							
NOTE 1 DSPD0	A9P1-30	DISPLAY DATA 0 (LSB)									30
DSPD1	A9P1-60	DISPLAY DATA 1									60
DSPD2	A9P1-29	DISPLAY DATA 2									29
DSPD3	A9P1-59	DISPLAY DATA 3									59
DSPD4	A9P1-28	DISPLAY DATA 4									28
DSPD5	A9P1-58	DISPLAY DATA 5									58
DSPD6	A9P1-27	DISPLAY DATA 6									27
DSPD7	A9P1-57	DISPLAY DATA 7									57
DSPD8	A9P1-26	DISPLAY DATA 8									26
DSPD9	A9P1-56	DISPLAY DATA 9									56
DSPD10	A9P1-25	DISPLAY DATA 10									25
DSPD11	A9P1-55	DISPLAY DATA 11									55
DSPD12	A9P1-24	DISPLAY DATA 12									24
DSPD13	A9P1-54	DISPLAY DATA 13									54
DSPD14	A9P1-23	DISPLAY DATA 14 (MSB)									23

NOTES: • = NOT USED

1. NOT USED IN HP 8753C AND HP 8702B

-TOR	A9 CPU		A10 DIGITAL IF		A11 PHASE LOCK		A12 REFERENCE		A13 FRAC N (ANLG)		A14 FRAC N (DIG)		A15 PRE-REGULATOR	A16 REAR PANEL	A18 DISPLAY[1]	FOCUS/ INT[1]	FAN SUPPLY	CHASSIS MISCELLANEOUS NOTES
XA8J2	XA9J1	XA9J2	XA10J1	XA10J2	XA11J1	XA11J2	XA12J1	XA12J2	XA13J1	XA13J2	XA14J1	XA14J2	J3	J6	J4	J2	J5	
			10, 40 21 51 22		10, 40 21 51 22		10, 40 21 51 22		10, 40* 21* 51*		10, 40 21 51							
			52 53	 18	52*		52					 48						
				  12										 32				AUX INPUT
	44	 33 4 3		 33 4 3														
		27 57 28 58		27 57 28 58														
		29 59 30 60		29 59 30 60														
		34 5 35		34 5 35														
				13		44												
	30 60 29 59 28														23 24 21 22 19			
	58 27 57 26 56														20 17 18 15 16			
	25 55 24 54 23														13 14 11 12 9			

WIRING LIST

	MNEMONIC	SOURCE	MNEMONIC DESCRIPTION	A1/A2 FRONT PANEL	A3 SOURCE	A4 R SAMPLER/ MIXER	A5 A SAMPLER/ MIXER	A6 B SAMPLER/ MIXER	A7 PULSE GEN	A8 POST- REGULATOR		A9 CPU		A DIGIT
				J1	XA3J1	XA4J1	XA5J1	XA6J1	XA7J1	XA8J1	XA8J2	XA9J1	XA9J2	XA10J1
NOTE 1	L DSPDAV	A9P1-53	DISPLAY DATA VALID									53		
	L DSPDISC	A9P1-22	DISPLAY DISCONNECT SENSE									22		
	L DSPRFD	A18J1-8	DISPLAY READY FOR DATA									52		
	L ENDIF	A9P2-17	L=ENABLE DIGITAL IF										17	
	L ENFN	A9P2-45	L=ENABLE FRAC N										45	
	L ENFP	A9P1-1	L=ENABLE FRONT PANEL	12								1		
	L ENPL	A9P2-15	L=ENABLE PHASE LOCK										15	
	L ENPREG	A9P2-46	L=ENABLE POST REG							45			46	
	L ENREF	A9P2-16	L=ENABLE REFERENCE										16	
	L ENRP	A9P2-47	L=ENABLE REAR PANEL										47	
	L ENSRC	A9P1-31	L=ENABLE SOURCE		2							31		
	EXT LEV	A16P1-50	EXTERNAL LEVELING (REAR PANEL)		40									
	EXTLEVCOM	A16P1-49	EXTERNAL LEVELING COMMON		39									
	L EXTTRIG	A16P1-7	L=EXTERNAL TRIGGER (REAR PANEL)											
	FANV+	A8P1-31	FAN VOLTAGE +							31				
	FANV-	A8P1-32	FAN VOLTAGE -							32				
	FM COIL +	A11P1-4, 34	FM COIL + (P/O YIG OSC)		37									
	FM COIL -	A11P1-3, 33	FM COIL - (P/O YIG OSC)		36									
	FNAPI1	A14P2-32	FRAC-N API1											
	FNAPI2	A14P2-3	FRAC-N API2											
	FNAPI3	A14P2-34	FRAC-N API3											
	FNAPI4	A14P2-4	FRAC-N API4											
	FNAPI5	A14P2-35	FRAC-N API5											
	FNBIAS	A14P2-5	FRAC-N BIAS											
	L FNHOLD	A14P2-2	L=FRAC-N HOLD											
	FNLATCH	A14P1-59	FRAC-N LATCH CLOCK											
	L FNPRET	A11P1-37	L=FRAC-N PRETUNE											
	FOCUS [1]			26										
	FN VCO TUN	A13P1-2	FRAC-N VCO TUNE (FROM FRAC-N ANALOG)											
	FNTUNE2	A11P1-8	FRAC-N TUNE 2 (FROM PHASE LOCK)						5					
	INTENS [1]			25										
	IA0	A9P1-34, A9P2-49	INSTRUMENT ADDRESS 0 (LSB)	10	5							34	49	
	IA1	A9P1-4, A9P2-20	INSTRUMENT ADDRESS 1		24							4	20	
	IA2	A9P1-33, A9P2-50	INSTRUMENT ADDRESS 2		4							33	50	
	IA3	A9P1-3, A9P2-21	INSTRUMENT ADDRESS 3		23							3	21	
	IA4	A9P1-32, A9P2-51	INSTRUMENT ADDRESS 4 (MSB)		3							32	51	
	IFA	A5P1-6	INTERMEDIATE FREQ (4KHz) A				6							4, 34
	IFB	A6P1-6	INTERMEDIATE FREQ (4KHz) B					6						7, 37
	IFR	A4P1-6	INTERMEDIATE FREQ (4KHz) R			6								1, 31

NOTES: • = NOT USED

1. NOT USED IN HP 8753C AND HP 87028

T-ATOR	A9 CPU		A10 DIGITAL IF		A11 PHASE LOCK		A12 REFERENCE		A13 FRAC N (ANLG)		A14 FRAC N (DIG)		A15 PRE-REGULATOR	A16 REAR PANEL	A18 DISPLAY[1]	FOCUS/ INT[1]	FAN SUPPLY	CHASSIS MISCELLANEOUS NOTES
XA8J2	XA9J1	XA9J2	XA10J1	XA10J2	XA11J1	XA11J2	XA12J1	XA12J2	XA13J1	XA13J2	XA14J1	XA14J2	J3	J6	J4	J2	J5	
	53 22 52														10 7 8			
	1	17 45 15		17 45* 15*		45* 15		45*		45*		45						
	31	46 16 47		16* 47*		16*		16						16				
				52										34 33 1				EXT AM EXT TRIGGER
					4, 34 3, 33												1 3	
										32 3 34 4 35		32 3 34 4 35						
					37					5 2 28	58 34	5 2						
																2		
					7 8				2		32 35							
																1		
	34 4 33 3 32	49 20 50 21 51		49 20 50 21 51		49 20 50 21 51		49 20 50 21 51		49 20 50 21 51		49 20 50 21 51		10 11 12 14 15				
			4, 34 7, 37 1, 31															

WIRING LIST

MNEMONIC	SOURCE	MNEMONIC DESCRIPTION	A1/A2 FRONT PANEL	A3 SOURCE	A4 R SAMPLER/ MIXER	A5 A SAMPLER/ MIXER	A6 B SAMPLER/ MIXER	A7 PULSE GEN	A8 POST- REGULATOR		A9 CPU		D
			J1	XA3J1	XA4J1	XA5J1	XA6J1	XA7J1	XA8J1	XA8J2	XA9J1	XA9J2	XA1
L INTFP	A2PX-19	L=INTERRUPT, FRONT PANEL	11								9		
L INTPF	A8P1-60	L=INTERRUPT, POWER FAIL							60			31	
L INTCOP	A10P2-2	L=INTERRUPT, DSP										2	
L INTEXT	A10P2-32	L=INTERRUPT, EXTERNAL										32	
L INTPL	A9J2-14	L=INTERRUPT, PHASE LOCK										14	
L INTRS232	A16P1-6	L=INTERRUPT, RS232										22	
L INTHPIB	A16P1-27	L=INTERRUPT, HP-IB										52	
L INWRITE	A9P1-2, A9P2-19	L=INSTRUMENT WRITE (H=READ)	9	22							2	19	
ID0	A9P1-8 , A9P2-23	INSTRUMENT DATA 0 (LSB)	1	28					7		8	23	
ID1	A9P1-38, A9P2-53	INSTRUMENT DATA 1	2	9					37		38	53	
ID2	A9P1-7, A9P2-24	INSTRUMENT DATA 2	3	27					6		7	24	
ID3	A9P1-37, A9P2-54	INSTRUMENT DATA 3	4	8					36		37	54	
ID4	A9P1-6, A9P2-25	INSTRUMENT DATA 4	5	26					5		6	25	
ID5	A9P1-36, A9P2-55	INSTRUMENT DATA 5	6	7					35		36	55	
ID6	A9P1-5, A9P2-26	INSTRUMENT DATA 6	7	25							5	26	
ID7	A9P1-35, A9P2-56	INSTRUMENT DATA 7 (MSB)	8	6							35	56	
MB	A14J1-5	MIDBAND (TO SAMPLER/MIXER)			9	9	9						
L HB	A10P1-28	L=HIGH BAND (TO REFERENCE)											26
L LB	A10P1-23	L=LOW BAND (TO MIXER/SAMPLER)			8			12					23
PLREF+	A12P1-54	PHASE LOCK REFERENCE +											
PLREF-	A12P1-58	PHASE LOCK REFERENCE -											
L POP	A8P1-30	L=POWER-ON/PRESET	14						30			1	
L SHDWN	A15P2-7	L=SHUTDOWN							3				
L SRCHOT	A3P1-3	L=SOURCE HOT (OVERTEMP)							8				
L SWP	A14P2-31	L=SWEEP											
YO COIL +	A11P1-2, 32	YIG OSC COIL +		35									
YO COIL -	A11P1-1, 31	YIG OSC COIL -		34									
L YOHOT	A3P1-33	L=YO HOT							9				
1V/GHz	A11P1-6, A11P1-36	1V/GHz		38									
2ndLO 1	A12P1-2, 32	2nd LO (TO MIXERS, 0 DEG)			11	11	11						
2ndLO 2	A12P1-4, 34	2nd LO (TO MIXERS, -90 DEG)			4	4	4						
4MHz HPIB	A9P2-48	4MHz CLOCK FOR HP-IB										48	
4MHz REF	A12P2-36	4MHz REF FOR DIGITAL IF											

NOTES: • = NOT USED

1. NOT USED IN HP 8753C AND HP 8702B

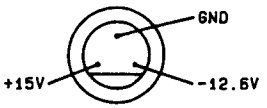
T- ATOR	A9 CPU		A10 DIGITAL IF		A11 PHASE LOCK		A12 REFERENCE		A13 FRAC N (ANLG)		A14 FRAC N (DIG)		A15 PRE- REGULATOR	A16 REAR PANEL	A18 DISPLAY[1]	FOCUS/ INT[1]	FAN SUPPLY	CHASSIS MISCELLANEOUS NOTES
XA8J2	XA9J1	XA9J2	XA10J1	XA10J2	XA11J1	XA11J2	XA12J1	XA12J2	XA13J1	XA13J2	XA14J1	XA14J2	J3	J6	J4	J2	J5	
	9																	
		31																
		2		2														
		32		32														
		14				43												
		22												2				
		52												13				
	2	19		19		19		19		19		19		8				
	8	23		23		23		23		23		23		16				
	38	53		53		53		53		53		53		21				
	7	24		24		24		24		24		24		22				
	37	54		54		54		54		54		54		23				
	6	25		25		25		25		25		25		24				
	36	55		55		55		55		55		55		25				
	5	26		26		26		26		26		26		26				
	35	56		56		56		56		56		56		27				
			28					32			5							
			23				23											
					24		54											
					28		58											
		1											7	31				NOT USED
				31								31						
					2, 32													NOT USED
					1, 31													
					6, 36													
							2, 32											
							4, 34											
		48		48										29				
				6				36										

WIRING LIST

MNEMONIC	SOURCE	MNEMONIC DESCRIPTION	A1/A2 FRONT PANEL	A3 SOURCE	A4 R SAMPLER/ MIXER	A5 A SAMPLER/ MIXER	A6 B SAMPLER/ MIXER	A7 PULSE GEN	A8 POST- REGULATOR		A9 CPU		
			J1	XA3J1	XA4J1	XA5J1	XA6J1	XA7J1	XA8J1	XA8J2	XA9J1	XA9J2	
+22V	A8P2-21, 51	+22Vdc		14						21, 51	10, 40		
+15V	A8P2-15, 16, 45, 46	+15Vdc		19	7	7	7	7		15, 16 45, 46	15, 16 45, 46		
+15VDSP +15VPP +15VSRC	A8P1-29 A8P2-4, 34 A8P2-26, 56	+15Vdc DISPLAY (ALSO FRONT PANEL) +15Vdc PROBE POWER +15Vdc SOURCE	13 17, 18	 15, 16					29	 4, 34 8*, 26, 56			
+7.5V	A8P2-10, 40	UNREG +5VA								10, 40	21*, 51*		2
+6V	A8P2-24, 54	+6Vdc PULSE GEN						3		24, 54			
+5VU	A8P2-20, 50	+5Vdc MICROCIRCUIT		17	2	2	2			20, 50	11*, 41*		
+5VCPU	A15P2-6	+5Vdc DIGITAL (CPU DISPLAY & FRONT PANEL)	23, 24						18, 19 48, 49			12, 13 42, 43	
+5VD1G	A15P2-3	+5Vdc DIGITAL (INSTRUMENT)		1					20, 21 50, 51			10, 11 40, 41	
+5VDSENSE +5VMEM	NOTE 4	+5Vdc SENSE (TO PREREGULATOR)							20*, 21* 50*, 51*			11	
GNDA	NOTE 5	GROUND ANALOG	19, 20	12, 13 32, 33	3, 5 10, 12	3, 5 10, 12	3, 5 10, 12	2, 4, 5, 6 8, 9, 11		MULTI- PINS	MULTI- PINS		
GNDD	NOTE 5	GROUND DIGITAL		21					22, 23 52, 53			8, 9 38, 39	
GNDDSENSE	NOTE 5	+5Vdc DIGITAL GROUND SENSE											
RET CPU	NOTE 6		21, 22						24, 25 54, 55			6, 7 36, 37	
-5.2V	A8P2-18, 48	-5.2Vdc		18				1		18, 48	13, 43		
-12.6V	A8P2-6, 36	-12.6Vdc PROBE POWER	15, 16							6, 36			
-15V	A8P2-11, 12, 41, 42	-15Vdc		20	1	1	1			11, 12 41, 42	19*, 20* 49*, 50*		

NOTES: * = NOT USED

1. NOT USED IN HP 8753C AND HP 8702B
2. DISPLAY POWER SUPPLIES CONNECTED DIRECTLY BETWEEN A8 AND A18.
3. +5VCPU AND +5VD CONNECTED TO A15.
4. +5VDSENSE CONNECTED TO +5VD ON A17.
5. GNDA, GNDD, GNDDSENSE, CONNECTED TOGETHER WITH SHIELD AND CHASSIS GROUND ON A17.
6. RET CPU AND GNDD CONNECTED AT A15.
7. FRONT PANEL PROBE POWER CONNECTOR VOLTAGES:



A8 DST-ILATOR	A9 CPU		A10 DIGITAL IF		A11 PHASE LOCK		A12 REFERENCE		A13 FRAC N (ANLG)		A14 FRAC N (DIG)		A15 PRE-REGULATOR	A16 REAR PANEL	A18 DISPLAY[1]	FOCUS/ INT[1]	FAN SUPPLY	CHASSIS MISCELLANEOUS NOTES
XA8J2	XA9J1	XA9J2	XA10J1	XA10J2	XA11J1	XA11J2	XA12J1	XA12J2	XA13J1	XA13J2	XA14J1	XA14J2	J3	J6	J4	J2	J5	
21, 51	10, 40		9, 39		9, 39		9, 39		9, 39		9, 39			33				
15, 16 45, 46	15, 16 45, 46		15, 16 45, 46		15, 16 45, 46		15, 16 45, 46		15, 16 45, 46		15, 16 45, 46							
4, 34 8*, 26, 56																		NOTE 2 PROBE POWER, NOTE 7
10, 40	21*, 51*		26*, 56*				30, 60		30, 60		30, 60							
24, 54																		
20, 50	11*, 41*		11, 41		11, 41		11, 41											
		12, 13 42, 43											6					NOTE 2, 3
		10, 11 40, 41		10, 11 40, 41		10, 11 40, 41		10, 11 40, 41		10, 11 40, 41		10, 11 40, 41	4	3, 4				NOTE 3
		11											5					NOTE 4
MULTI-PINS	MULTI-PINS		MULTI-PINS		MULTI-PINS		MULTI-PINS	MULTI-PINS	MULTI-PINS	MULTI-PINS	MULTI-PINS	MULTI-PINS	9, 10	17, 18 19, 20	3, 5	3, 5		NOTE 5 AUX IN COMMON
		8, 9 38, 39		7, 8, 9 37, 38 39		7, 8, 9 37, 38 39		7, 8, 9 37, 38 39		7, 8, 9 37, 38 39		7, 8, 9 37, 38 39	2	5, 6 7, 8 28, 30	25, 26			NOTE 5
													3					NOTE 5
		6, 7 36, 37											1					NOTE 5 NOTE 6
18, 48	13, 43		13, 43		13, 43		13, 43		13, 43		13, 43							
6, 36																		PROBE POWER, NOTE 7
11, 12 41, 42	19*, 20* 49*, 50*		19, 20 49, 50		19, 20 49, 50		19, 20 49, 50		19, 20 49, 50		19, 20 49, 50							NOTE 2

INTRODUCTION

Use these procedures if you have read the *Troubleshooting* section and you think the problem is in the analyzer. These are fast procedures to verify the four functional groups in sequence, and determine which group is faulty.

The four functional groups are power supplies, digital control, source, and receiver. Descriptions of these groups are provided in *Theory of Operation*.

The checks in the following pages must be performed in the order presented. If one of the procedures fails, it is an indication that the problem is in the functional group checked. Go to the troubleshooting information for the indicated group, to isolate the problem to the defective assembly.

Figure 1 diagrams the troubleshooting organization.

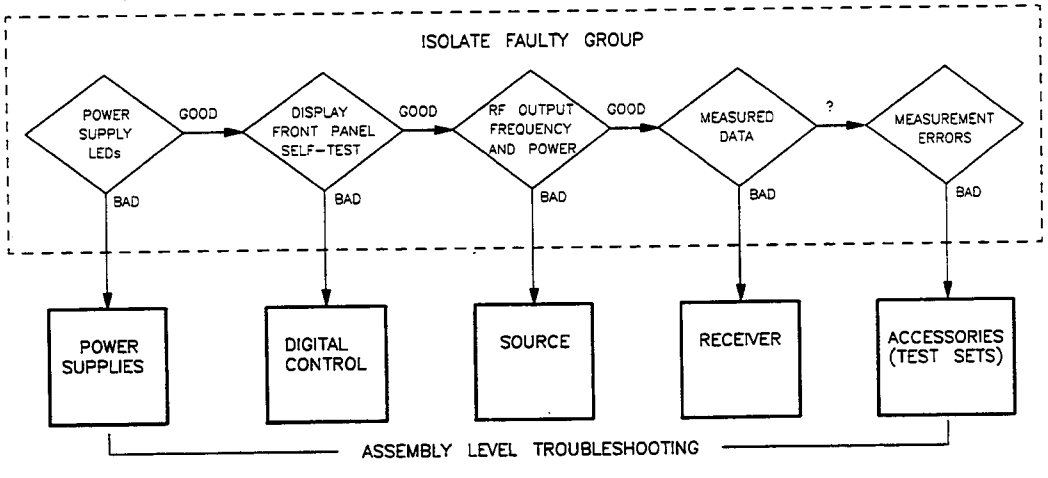


Figure 1. Troubleshooting Organization

POWER SUPPLY

Check the Rear Panel LEDs

Turn instrument power on. Note the condition of the two LEDs visible through holes in the rear panel.

- The upper (red) LED should be off.
- The lower (green) LED should be on.

Check the A8 Post-Regulator LEDs

Remove the instrument's top cover. Turn power on. Inspect the green LEDs along the top edge of the A8 post-regulator assembly. There are ten LEDs in the HP 8753A/B and 8702A. There are nine in the HP 8753C and 8702B (one is under the PC board stabilizer bar.) These LEDs indicate proper regulated supply operation.

- All green LEDs should be on.
- The fan should be audible.

In case of difficulty, refer to the troubleshooting information behind the *Power Supply* tab.

DIGITAL CONTROL

Observe the Power Up Sequence

Turn instrument power off, then on. The following sequences should take place in a few seconds:

Front Panel	1. All six amber LEDs light temporarily. 2. All six amber LEDs turn off, except the CH 1 LED (see Figure 2).
A9 CPU Board	**HP 8753A/B and 8702A** 1. The four (or eight) red LEDs atop the A9 assembly turn on. 2. The LED nearest the front of A9 goes out. 3. Three A9 LEDs flicker randomly (one may appear to be on steadily). **HP 8753C and 8702B** 1. All 4 red LEDs turn on. 2. The LED nearest the front stays steadily on. 3. The other 7 LEDs flicker randomly.
CRT	1. The display comes up bright and focused.

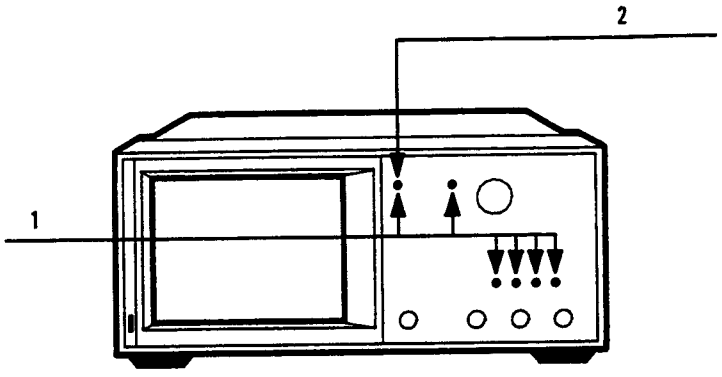


Figure 2. Front Panel LED Turn On Sequence

Verify Internal Tests Passed

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS] [INTERNAL TESTS] [EXECUTE TEST]***. The display should indicate:

TEST
1 PRESET PASS

Then press **[0] [X1]** ***[EXECUTE TEST]***. The display should indicate:

TEST
0 ALL INT PASS

If phase lock error messages are present, this test may stop without passing or failing. In this case, continue with the next procedure to check the source.

If any of the above procedures lead to unexpected results, or if the CRT indicates a specific test failure, that internal test (and possibly others) have failed; the analyzer reports the first failure detected. Refer to the troubleshooting information behind the *Digital Control* tab. If the CRT indicates failure but does not identify the test, use the UP arrow to search for the failed test. Then refer to "Digital Control." Likewise, if the response to front panel or HP-IB commands is unexpected, troubleshoot the digital control group.

Next, perform the Analog Bus test:

Press **[19] [x1]** ***[EXECUTE TEST]***. If this test fails, refer to the *Digital Control* section. If this test passes, continue with the next procedure to check the source.

SOURCE

Phase Lock Error Messages

- NO IF FOUND: CHECK R INPUT LEVEL
  The first IF was not detected during the pretune stage of phase lock. Ensure that the R input is connected with at least −35 dBm power to R.
- NO PHASE LOCK: CHECK R INPUT LEVEL
  The first IF was detected at the pretune stage but phase lock could not be acquired thereafter.
- PHASE LOCK LOST
  Phase-lock was acquired but then lost.
- PHASE LOCK CAL FAILED
  An internal phase lock calibration routine is automatically executed at power-on, when pretune values drift, or when phase lock problems are detected. A problem spoiled a calibration attempt.
- POSSIBLE FALSE LOCK
  The instrument is achieving phase lock but possibly on the wrong harmonic comb tooth.
- SWEEP TIME TOO FAST
  The fractional-N and the digital IF circuits have lost synchronization.

The error messages listed above are usually indicative of a source failure or improper instrument configuration. (Ensure that the R input is receiving at least −35 dBm power). Continue with this procedure.

Check Source Output Power

1. Connect the equipment as shown in Figure 3 below.

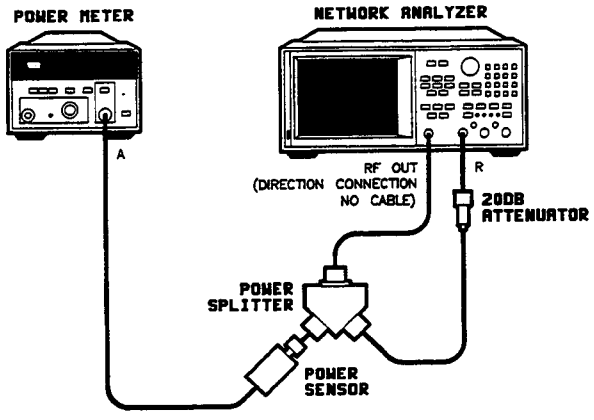


Figure 3. Equipment Setup for Source Power Check

2. Zero and calibrate the power meter if necessary. Press **[PRESET]** on the analyzer to initialize the instrument.

   NOTE: On HP 8702s, press **[CAL]** ***[DEVICE TYPE] [E/E]***.

3. On the analyzer, press **[MENU]** ***[CW FREQ]*** **[3][0][0][K/m]** to output a CW 300 kHz signal. The power meter should read approximately −6 dBm. (The frequency response of the power splitter may account for up to ±1 dB difference.)

4. Press **[1][6][M/u]** to change the CW frequency to 16 MHz. The power output power should remain approximately −6 dBm throughout the instruments's frequency range. Repeat at 1 GHz by pressing **[1][G/n]**, and at 3 GHz by pressing **[3] [G/n]**.

5. Press ***[POWER]*** **[2][0][x1]** to increase the output power to 20 dBm.

6. Repeat steps 3 and 4. This time the power meter should read approximately 14 dBm at all four frequencies.

If any incorrect power levels are measured, refer to the *Source* section to continue troubleshooting.

No Oscilloscope or Power Meter? Try the ABUS

Monitor ABUS node 16. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MEAS]** ***[S PARAMETERS] [ANALOG IN]*** **[1] [6] [x1] [FORMAT] [MORE]** ***[REAL]*** **[SCALE REF]** ***[AUTOSCALE]***.

The display should resemble Figure 4.

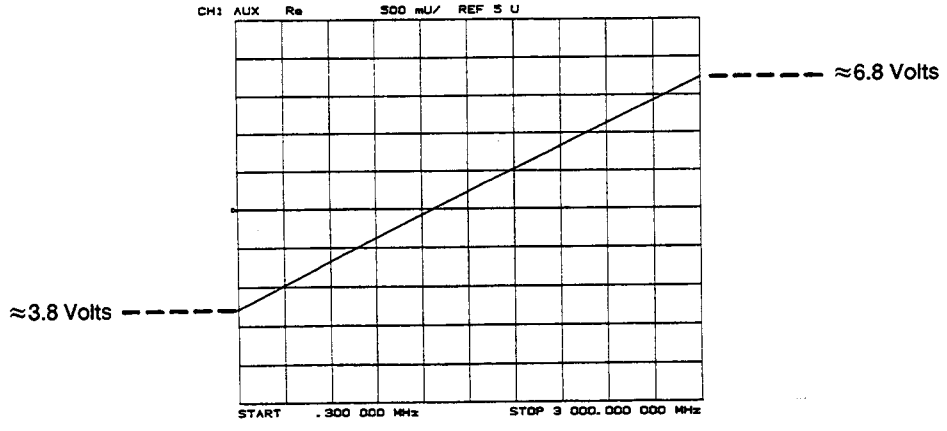


Figure 4. ABUS Node 16: 1V/GHz

If any of the above procedures provide unexpected results, or if error messages are present, refer to the troubleshooting information behind the *Source* tab.

RECEIVER

Observe the measurement traces displayed by all three inputs. Connect a power splitter directly to RF OUT. Connect RF cables from the splitter outputs to inputs R and A. Press **[PRESET]** **[MEAS]** ***[R] [SCALE REF] [.] [5] [x1] [MKR FCTN] [MARKER→REFERENCE]***. The trace should resemble Figure 5. Next, press **[MEAS]** ***[A]*** to check the A channel trace. Move the A input cable to the B input and press ***[B].*** Note the condition of the traces. They should resemble Figure 5.

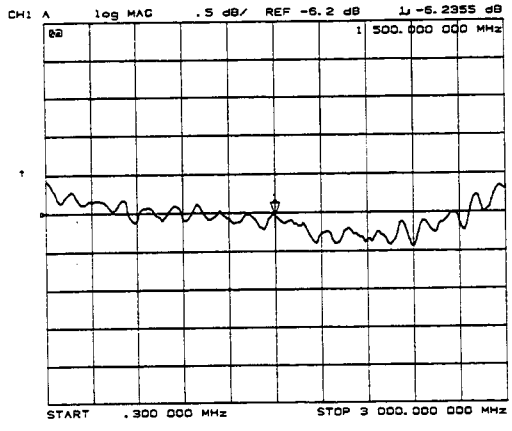


Figure 5. Typical Measurement Trace

If the source is working but the R, A, or B input traces appear to be in error, refer to the troubleshooting information behind the *Receiver* tab.

The following symptoms may also indicate receiver failure.

Receiver Error Messages

- OVERLOAD ON INPUT [A/B/R]; POWER REDUCED
  The power level at one of the inputs exceeded about +2 dBm. The analyzer reduced the RF OUT power to minimum as indicated by a P↓ on the CRT (left side). Decrease power. Press **[MENU]** ***[POWER] [POWER TRIP OFF]*** to turn off the power trip (see chapter 3 of the *Reference* for details).

Bad Data

Any trace data that appears to be below the noise floor of the instrument (−100 dBm) is indicative of a receiver failure.

ACCESSORIES

Accessories Error Messages

- POWER PROBE SHUT DOWN!
  The biasing supplies to a front panel powered device (like a probe or lightwave or millimeter module) are shut down due to excessive current draw. Troubleshoot the device.

If the instrument has passed all of the above checks but is still making incorrect measurements, suspect the system accessories. Accessories such as RF or interconnect cables, calibration and verification kit devices, test sets can all induce system problems.

Reconfigure the system as it is normally used and reconfirm the problem. Continue with the *Accessories* troubleshooting section.

ISOLATE FAULTY GROUP WORKSHEET (1 of 2)

(Photocopy for multiple use.)

User _____ Date _____

Model Number _____ Serial Number _____

Firmware Revision _____ Phone _____

Complaint _____

_____

_____

	YES (Normal)	NO (Abnormal)
POWER SUPPLY Turn instrument on.		
1. Fan operating?	☐	☐
2. Rear panel: green LED on? red LED off?	☐	☐
3. All 10 (9) A8 green LEDs on?	☐	☐

If any "NO" boxes are checked, see the *Power Supply* section.

DIGITAL CONTROL Cycle power.		
4. Do all six front panel LEDs turn on, then all except CH 1 LED turn off?	☐	☐
5. CRT bright and focused?	☐	☐
6. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]***. PRESET test passed?	☐	☐
7. Press **[0][x1]** ***[EXECUTE TEST]***. ALL INT tests pass?	☐	☐
8. Press **[1][9][x1]** ***[EXECUTE TEST]***. ABUS test pass?	☐	☐

If any "NO" boxes are checked, see the *Digital Control* section.

SOURCE Press **[PRESET]**.		
9. Does the instrument phase lock (is the display free of phase lock error messages)?	☐	☐
10. Connect power splitter to RF OUT and check output power. Is the power correct?	☐	☐

If any "NO" boxes are checked, see the *Source* section.

ISOLATE FAULTY GROUP WORKSHEET (2 of 2)

(Photocopy for multiple use.)

RECEIVER	Connect power splitter to RF OUT and splitter outputs to the R and A inputs.	**YES** (Normal)	**NO** (Abnormal)
11.	Press **[PRESET] [MEAS]** ***[R]*** **[SCALE REF] [.][5][x1] [MKR FCTN]** ***[MARKER→REFERENCE]***. Does the display show a trace similar to Figure 5?	☐	☐
12.	Press **[MEAS]** ***[A]***. Does the display show a trace similar to Figure 5?	☐	☐
13.	Move the A input cable to the B input and press ***[B]***. Does the display show a trace similar to Figure 5?	☐	☐

If any "NO" boxes are checked, see the *Receiver* section.

ACCESSORIES

If the instrument has passed all of the above tests (all "YES" boxes checked) but is still making incorrect measurements, the problem is most likely with the test set, cables, calibration kit devices, or lightwave system components where applicable. Refer to the *Accessories* section.

SOLUTION _____

_____

_____

_____

NOTE: Following assembly replacement, refer to the *Related Service Procedures* table in the *Post-Repair Procedures* section. The table specifies adjustment and verification procedures to be followed after an assembly is replaced.

Adjustments Performed	**Verifications Performed**
_____	_____
_____	_____
_____	_____

Power Supply Troubleshooting

REPAIR SEQUENCE

Troubleshooting: identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

Use this procedure only if you have read *Isolate Faulty Group*, and you believe the problem is in the power supply. The procedure is designed to let you identify the bad assembly within the power supply functional group in the shortest possible time.

If an assembly is replaced, refer to the table of *Related Service Procedures* in the *Post-Repair Procedures* section. It tells what additional tests or adjustments need to be done after replacing any assembly.

Figure 1 shows the power supply group in simplified block diagram form. The following assemblies make up the power supply group:

A8 post-regulator
A15 preregulator

All assemblies, however, are related to the power supply group because power is supplied to each assembly.

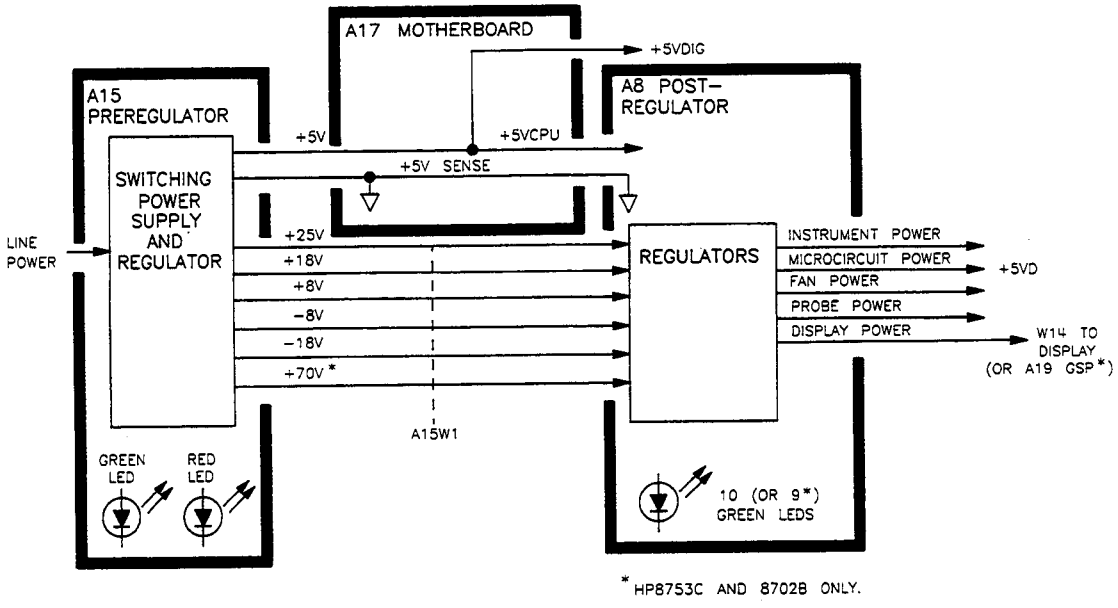


Figure 1. Power Supply Group Simplified Block Diagram

Refer to the Power Supply Block Diagram (Figure 8 at the end of this section) to see signal paths and specific connector pin numbers.

Table 1. Power Supply Troubleshooting Summary

This summary gives an overview of the power supply troubleshooting procedure. Technicians who are already familiar with troubleshooting the power supply may save time by following this summary instead of reading the entire procedure. Headings in this summary match the headings in the procedure.

START HERE

- Check the Green LED and Red LED on A15
- Check the Green LEDs on A8
- Measure the Post-Regulator Voltages

FIND OUT WHY THE GREEN LED ON A15 IS NOT ON STEADILY

- Check the Line Voltage, Selector Switch, and Fuse

FIND OUT WHY THE RED LED ON A15 IS ON OR FLASHING

- Disconnect A15W1
- Check A15 and Related Assemblies
    - Measure Voltages on A15W1
    - Remove Assemblies
    - Install A9 and Disconnect Display Cable
    - Remove Assemblies Again
    - Check the Operating Temperature
    - Inspect Motherboard

FIND OUT WHY THE GREEN LEDS ON A8 ARE NOT ALL ON

- Remove A8 from Motherboard Connector, Maintain A15W1 Cable Connection
- Check the A8 Fuses and Voltages
- Remove Assemblies
- Install A9 and Disconnect Display Power Cable
- Briefly Disable the Shutdown Circuitry
    - Cross-Check the Wiring List
    - Remove Assemblies One at a Time
- Inspect Motherboard

ERROR MESSAGES

- Power Supply Shut Down!
- Power Supply Hot
- Probe Power Shut Down!
    - Check Fuses and Isolate A8

FAN TROUBLESHOOTING

- Fan Speeds
- Check the Fan Voltages
- Short A8TP3 to Ground

INTERMITTENT PROBLEMS

START HERE

If an error message appears on the display, refer to *Error Messages* near the end of this procedure.

If the fan is not working, refer to *Fan Troubleshooting.*

Check the Green LED and Red LED on A15

Turn the instrument on and look at the rear panel of the analyzer. Check the two power supply diagnostic LEDs on the A15 preregulator casting by looking through the holes located to the left of the line voltage selector switch, (see Figure 2).

During normal operation, the bottom (green) LED is on and the top (red) LED is off. If these LEDs are normal, then A15 is 95% verified.

- If the green LED is not on steadily, refer to *Find Out Why the Green LED on A15 is Not On Steadily* in this procedure.
- If the red LED is on or flashing, refer to *Find Out Why the Red LED on A15 is On or Flashing* in this procedure.

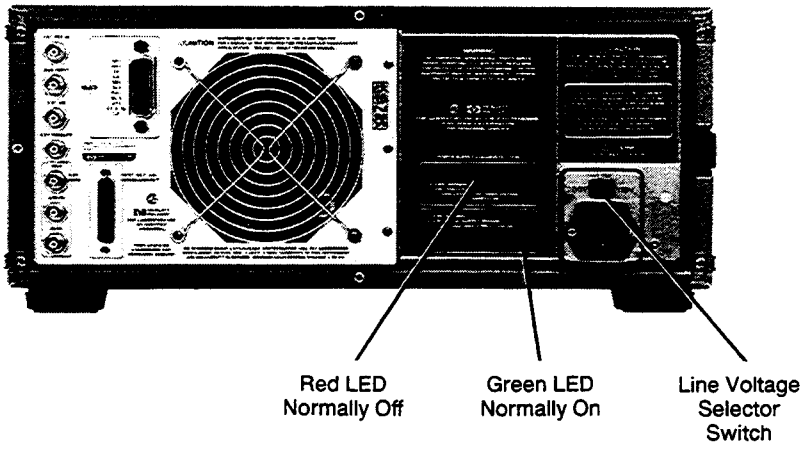


Figure 2. Location of A15 Diagnostic LEDs

Check the Green LEDs on A8

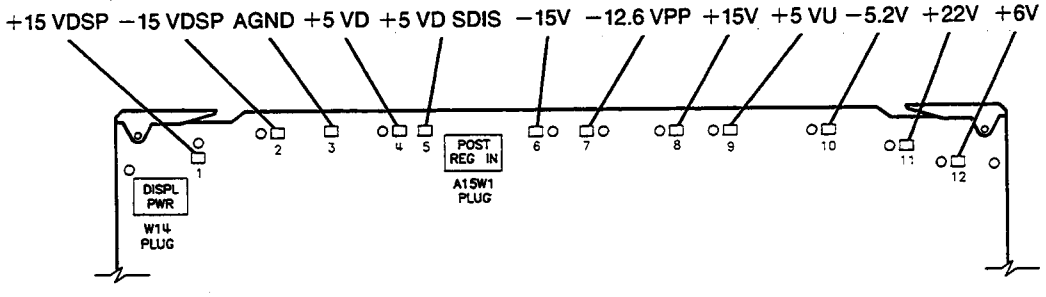
Remove the top cover of the instrument and locate the A8 post-regulator; use the location diagram under the top cover if necessary. Check to see if the green LEDs on the top edge of A8 are on. There are ten green LEDs in the HP 8753A/B and 8702A; there are nine green LEDs in the HP 8753C and 8702B (one is not visible without removing the PC board stabilizer).

- If all of the green LEDs on the top edge of A8 are on, there is a 95% confidence level that the power supply is verified. To confirm the last 5% uncertainty of the power supply, refer to *Measure the Post-Regulator Voltages* (next).
- If any LED on the A8 post-regulator is off or flashing, refer to *Find out Why the Green LEDs on A8 Are Not All On* in this procedure.

Measure the Post-Regulator Voltages

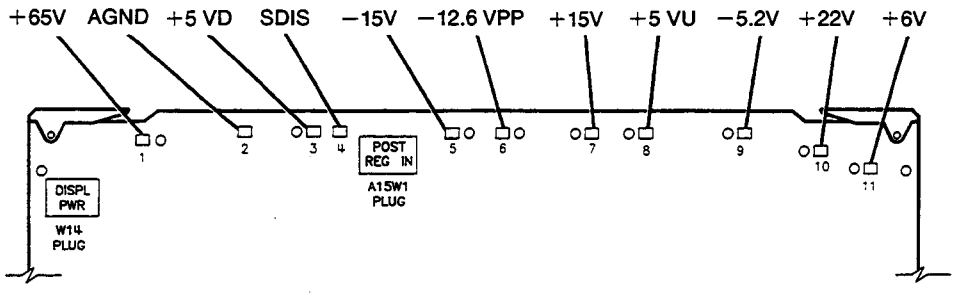
Measure the DC voltages on the test points of A8 with a voltmeter. Refer to Figure 3 for supply voltages and limits.

A8 Post Regulator Assembly for the HP 8753A/B and 8702A



TP	Supply	Range	TP	Supply	Range
1	+15 VDSP	+14.5 to +15.5	7	−12.6 VPP	−12.1 to −12.8
2	−15 VDSP	−14.4 to −15.6	8	+15V	+14.5 to +15.5
3	AGND		9	+5 VU	+5.05 to +5.35
4	+5 VD	+4.9 to +5.3	10	−5.2 V	−5.0 to −5.4
5	SDIS		11	+22V	+21.3 to +22.7
6	−15V	−14.4 to −15.6	12	+6V	+5.8 to +6.2

Figure 3. A8 Post-Regulator Test Point Voltages (1 of 2)



TP	Supply	Range	TP	Supply	Range
1	+65V	+64.6 to +65.4	7	+15V	+14.5 to +15.5
2	AGND		8	+5 VU	+5.05 to +5.35
3	+5 VD	+4.9 to +5.3	9	−5.2 V	−5.0 to −5.4
4	SDIS		10	+22V	+21.3 to +22.7
5	−15V	−14.4 to −15.6	11	+6V	+5.8 to +6.2
6	−12.6 PP	−12.1 to −12.8			

Figure 3. A8 Post-Regulator Test Point Voltages (2 of 2)

FIND OUT WHY THE GREEN LED ON A15 IS NOT ON STEADILY

If the green LED is not on steadily, the line voltage is missing or is not enough to power the instrument.

Check the Line Voltage, Selector Switch, and Fuse

Check the main power line cord, line fuse, line selector switch setting, and actual line voltage to see that they are all correct. Figure 4 shows how to remove the line fuse, using a small flat-bladed screwdriver to pry out the fuseholder. Figure 2 shows the location of the line voltage selector switch. Use a small flat-bladed screwdriver to select the correct switch position.

- If the A15 green LED is still not on steadily, replace A15.

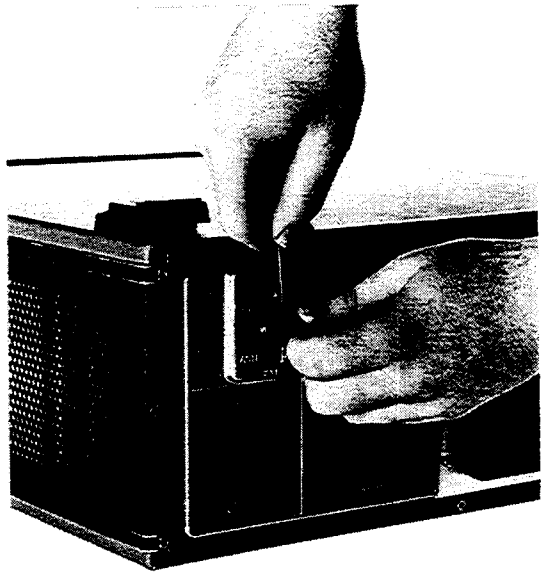


Figure 4. Removing Line Fuse

FIND OUT WHY THE RED LED ON A15 IS ON OR FLASHING

If the red LED is on, the problem may be in the A15 preregulator, the A8 post-regulator, the +5V digital supply, or any of the assemblies obtaining power from the supplies.

Disconnect A15W1

Disconnect the cable A15W1 from the A8 post-regulator.

- If the red LED goes out, the +5V digital supply in A15 is verified. The problem is probably in the A8 post-regulator or one of the assemblies obtaining power from it. Continue to *Check A15 and Related Assemblies* to first verify that the inputs to A8 are correct, then verify the associated assemblies.
- If the red LED is still on or flashing, the problem is probably in the A15 preregulator or the +5V digital supply, or one of the assemblies obtaining power from it. Continue with *Remove Assemblies* (in *Check A15 and Related Assemblies.)*

Check A15 and Related Assemblies

The following paragraphs systematically check the assemblies to find the bad one.

Measure Voltages on A15W1. Use a voltmeter with a small probe to measure the output voltages of A15. Refer to Figure 5a (HP 8753A/B and 8702A) or 5b (HP 8753C and 8702B) which illustrate the connector and show nominal voltages with the connector plugged in and not plugged in.

- If the voltages are not within tolerance, replace A15.
- If the voltages are within tolerance A15 is verified. Continue to the next paragraph.

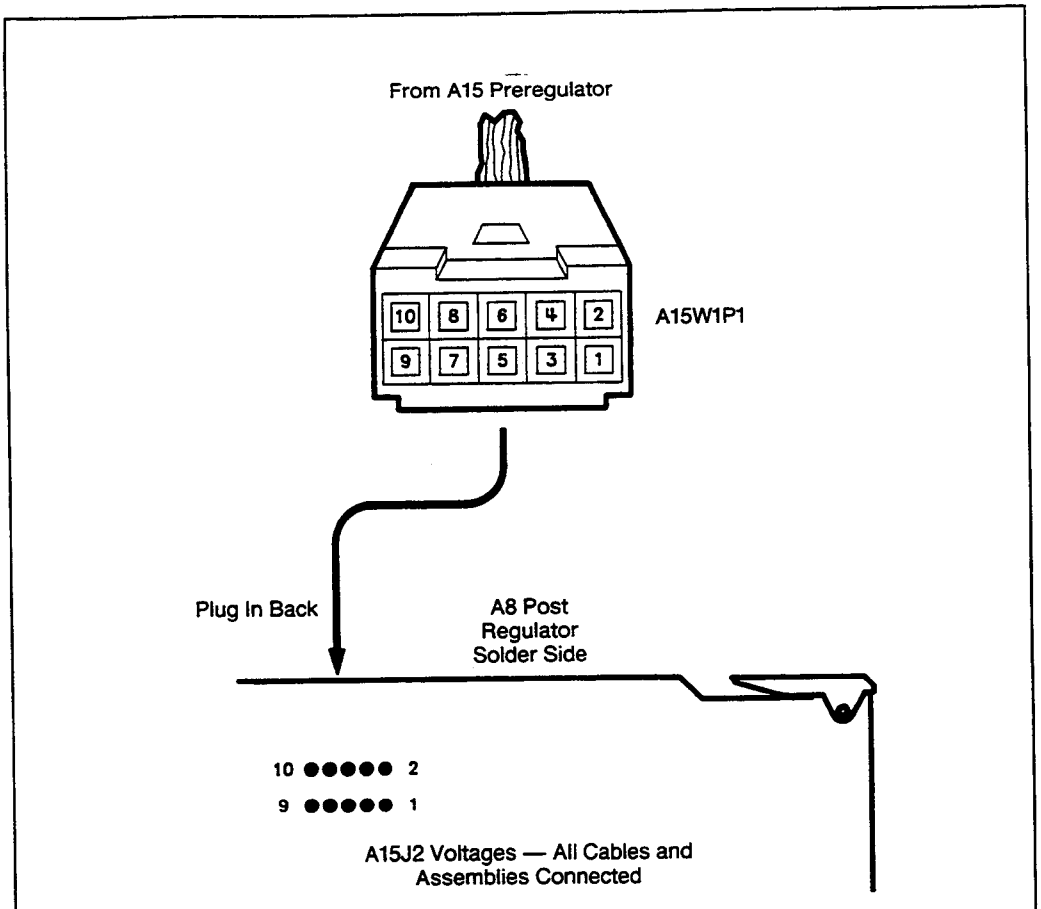
Remove Assemblies. Check loading from the assemblies that are supplied by A15. Connect the A15W1 cable to A8. Remove the following assemblies and then turn the instrument on:

A8	A12
A9	A13
A10	A14
A11	All cable connections to A19 (HP 8753C and 8702B)

- If the A15 LED is still off, continue with *Install A9 and Disconnect Display Cable* (HP 8753A/B and 8702A only) or *Remove Assemblies Again* (HP 8753C and 8702B).
- If the A15 red LED is off, turn off the analyzer power. Plug the A8 assembly into the motherboard. If the LED lights, replace the A8 assembly.

For the HP 8753C and 8702B, next connect the A19 to A8 power supply cable and the W20 ribbon cable between A9 and A19. If the LED turns on, replace A19.

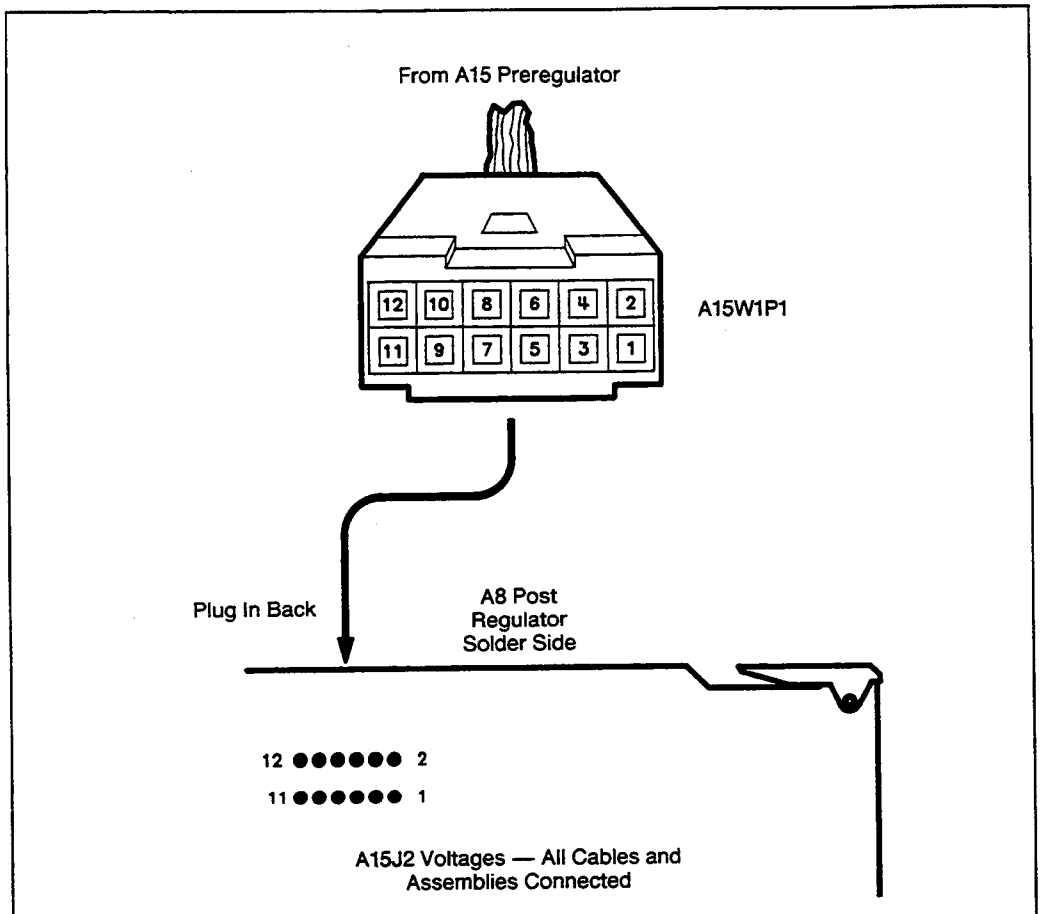
For all analyzers, continue to plug in the rest of the assemblies until the red LED lights. Replace the assembly that causes the LED to light.



Pin	A15W1P1 (Disconnected) Voltages	A8J2 (Connected) Voltages	A15 Preregulator Mnemonic
1,2	+22.4 to +33.6	+17.0 to +18.4	+18V
3,4	−22.4 to −33.6	−17.0 to −18.4	−18V
5	N/C	+7.4 to +8.0	+8V
6	+9.4 to +14	+7.4 to +8.0	+8V
7,8	−9.4 to −14	−6.7 to −7.3	−8V
9	+32 to +48	+24.6 to +26.6	+25V
10	N/C	+24.6 to +26.6	+25V

*The +5VD supply must be loaded by one or more assemblies at all times, or the other voltages will not be correct. It connects to motherboard connector A17J3 Pin 4.

Figure 5a. A15W1P1 Plug Detail and Output Voltages (HP 8753A/B and 8702A)



Pin	A15W1P1 (Disconnected) Voltages	A8J2 (Connected) Voltages	A15 Preregulator Mnemonic
1,2	+125 to +100	+68 to +72	+70V
3,4	+22.4 to +33.6	+17.0 to +18.4	+18V
5,6	−22.4 to −33.6	−17.0 to −18.4	−18V
7	N/C	N/C	N/C
8	+9.4 to +14	+7.4 to +8.0	+8 V
9,10	−9.4 to −14	−6.7 to −7.3	−8 V
11	+32 to +48	+24.6 to +26.6	+25V
12	N/C	N/C	N/C

*The +5VD supply must be loaded by one or more assemblies at all times, or the other voltages will not be correct. It connects to motherboard connector A17J3 Pin 4.

Figure 5b. A15W1P1 Plug Detail and Output Voltages (HP 8753C and 8702B)

Install A9 and Disconnect Display Cable. Turn the instrument off. Insert A9 into the motherboard connector, remove the display power cable (W14), and turn the instrument on. Figure 6 shows the location of the display power cable.

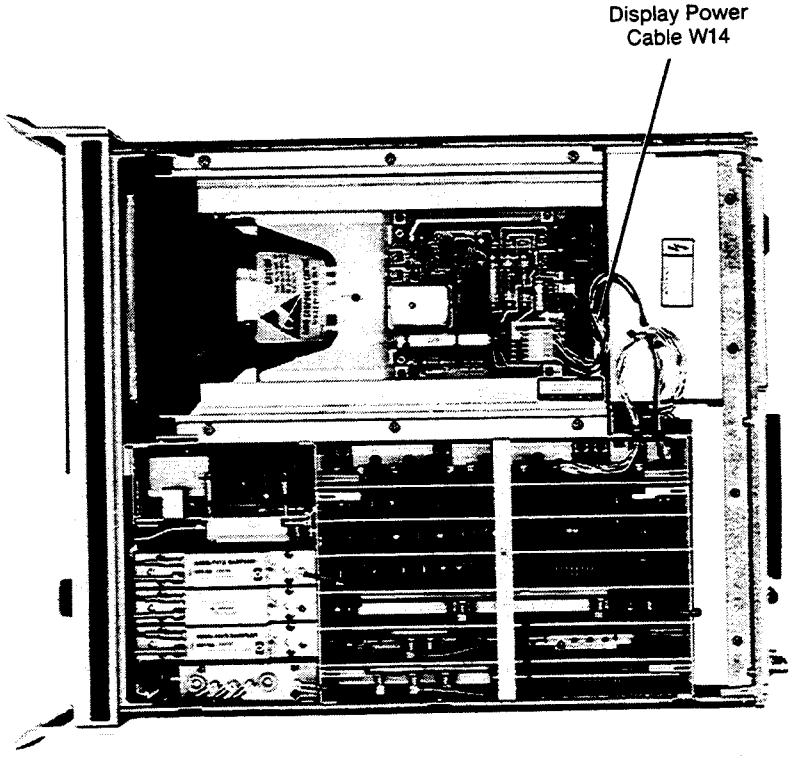


Figure 6. A18 Display Power Cable Location

- If the A15 red LED goes off, the display is bad.
- If the A15 red LED is still on or flashing, reconnect the display power cable and continue with this procedure.

Remove Assemblies Again. Turn the instrument off. One at a time and in the order shown, remove the following assemblies from their motherboard connectors until the red LED goes off. The assembly that causes the red LED to go out when it is removed from its motherboard connector is bad.

A3
A1/A2
A16

- If the red LED is still on or flashing, continue with this procedure.

Check the Operating Temperature. The temperature sensing circuitry inside the A15 pre-regulator may be shutting down the supply. Make sure the temperature of the open air operating environment does not exceed 55°C (131°F), and that the instrument fan is operating.

- If the fan does not seem to be operating correctly, refer to *Fan Troubleshooting* at the end of this procedure.
- If there does not appear to be a temperature problem, it is likely that A15 is bad.

Inspect Motherboard. If the red LED is still on after replacement or repair of A15, turn the instrument off and inspect the motherboard for solder bridges, and other noticeable defects. Use an ohmmeter to check for shorts. The +5VD, +5VCPU, or +5VDSENSE lines may be bad. Refer to the wiring list (in the *Troubleshooting* section) and troubleshoot these suspected power supply lines on the A17 motherboard.

FIND OUT WHY THE GREEN LEDS ON A8 ARE NOT ALL ON

The green LEDs along the top edge of the A8 post-regulator are normally on.

Flashing LEDs on A8 indicate that the shutdown circuitry on the A8 post-regulator is protecting power supplies from overcurrent conditions by repeatedly shutting them down. This may be caused by supply loading on A8 or on any other assembly in the instrument.

Remove A8 From Motherboard Connector, Maintain A15W1 Cable Connection

Turn the instrument off. Remove A8 from its motherboard connector but keep the A15-to-A8 cable (A15W1) connected to A8. Remove the display power cable W14 (illustrated in Figure 6). Short AGND (analog ground) to chassis ground with a clip lead and then turn the instrument on.

- If any A8 green LEDs other than +5VD is still off or flashing, continue with this procedure.
- If all LEDs are now on steadily except for the +5VD LED, the A15 preregulator and A8 post-regulator are working properly and the trouble is excessive loading somewhere after the motherboard connections at A8. Refer to *Remove Assemblies* immediately following *Check the A8 Fuses and Voltages* below.

Check the A8 Fuses and Voltages

Check the fuses along the top edge of A8. If any A8 fuse has burned out, replace it. If it burns out again when power is applied to the instrument, A8 or A15 is bad. Determine which assembly has failed as follows.

Remove the A15W1 cable at A8 and measure the voltages at A15W1P1 with a voltmeter having a small probe. Compare the measured voltages with those in Figure 5.

- If the voltages are within tolerance, replace A8.
- If the voltages are not within tolerance, replace A15.

If the A8 green LEDs are now on, the A15 preregulator and A8 post-regulator are working properly and the trouble is excessive loading somewhere after the motherboard connections at A8.

Remove Assemblies

Install A8. Reconnect the display cable on HP 8753A/B and 8702A. Remove the jumper from AGND to chassis ground. Remove the following assemblies and turn the instrument on.

A9	A13
A10	A14
A11	A18 (HP 8753A/B and 8702A)
A12	All cable connections to A19 (HP 8753C and 8702B)

- If any of the A8 green LEDs are off or flashing, it is likely that the assemblies just removed are not causing the problem.
- If all A8 green LEDs are now on, turn off instrument power.

For the HP 8753C and 8702B only, connect W14 between A8 and A19 and connect W20 to A9 and A19. Turn on analyzer power. If the LEDs are off or blinking, replace the A19 assembly. If the LEDs are still on, connect the display power supply ribbon cable to the A19 assembly. Turn on analyzer power. If the LEDs are off, replace the A18 display. If the LEDs are still on, continue with the next step.

For all analyzers, reinstall each assembly one at a time. Turn on analyzer power after each is installed. The assembly that causes the A8 green LEDs to go off or flash is suspect. It is possible that this condition is caused by the post-regulator supplying insufficient current. To check this, repeat the *Remove Assemblies* step but replace the assemblies in a different order to change the loading. If the same assembly appears to be faulty, replace that assembly. If a different assembly appears faulty, A8 is most likely bad (unless both of the other assemblies are bad).

Install A9 and Disconnect Display Power Cable (HP 8753A/B and 8702A only)

Turn the instrument off and install A9. Remove the display power cable W14 (illustrated in Figure 6) and turn the instrument on.

- If all A8 green LEDs are now on, replace or repair the A18 display. The display manual part number is in the Replaceable Parts section.
- If any of the A8 green LEDs are off or flashing, continue with the next paragraph.

Briefly Disable the Shutdown Circuitry

In this step, the protective shutdown circuitry is disabled for a short time, and the supplies are forced on (including shorted supplies) with a 100% duty cycle.

CAUTION

Damage to components or to circuit traces may occur if the SDIS test point A8TP5 (HP 8753A/B and 8702A) or A8TP4 (HP 8753C and 8702B) is shorted to chassis ground for more than a few seconds while supplies are shorted.

Connect A8TP5 (HP 8753A/B and 8702A) or A8TP4 (HP 8753C and 8702B) (SDIS) to chassis ground with a jumper wire. Turn the instrument on and note the signal mnemonics and test points of any LEDs that are off. IMMEDIATELY REMOVE THE JUMPER WIRE.

Cross-Check the Wiring List. Refer to the *Wiring List* (in Troubleshooting) and Figure 8 (at the end of this section) and note the mnemonics of any additional signals that may connect to any A8 test point that showed a fault in the previous step. Cross reference all assemblies that use the power supplies whose A8 LEDs went out when A8TP5 (or A8TP4) (SDIS) was connected to chassis ground. Make a list of these assemblies. Delete the following assemblies from your list as they have already been verified.

A8
A9
A10
A11
A12
A13
A14
A18
A19 (HP 8753C and 8702B)

Remove Assemblies One at a Time. Of those assemblies that are left on the list, remove them from the instrument one at a time. If all the LEDs light, the assembly that allows them to light is bad. Remove the assemblies in the order shown below; the last assembly listed takes the longest time to remove.

A3
A7
A4
A5
A6
A1/A2
A16

- If the A8 green LEDs are still not on steadily, continue with the next paragraph.

Inspect Motherboard

Inspect the A17 motherboard for solder bridges and shorted traces. In particular, inspect the traces that carry the supplies whose LEDs faulted when A8TP5 (or A8TP4) (SDIS) was grounded earlier.

ERROR MESSAGES

Three error messages are associated with the power supplies functional group. They are shown here.

Power Supply Shut Down!

One or more supplies on the A8 post-regulator assembly has been shut down due to one of the following conditions: overcurrent, overvoltage, or undervoltage. Refer to *Find Out Why the Red LED on A15 is On or Flashing* earlier in this procedure.

Power Supply Hot

The temperature sensors on the A8 post-regulator assembly have detected an overtemperature condition. The regulated power supplies on A8 have been shut down.

Check the temperature of the operating environment; it should not be greater than +55°C (131°F). The fan should be operating and there should be at least 15 cm (6 in) spacing behind and all around the instrument to allow for proper ventilation.

Probe Power Shut Down!

The front panel RF probe biasing supplies are shut down due to excessive current draw. These supplies are +15VPP and −12.6VPP, both supplied by the A8 post-regulator. +15VPP is derived from the +15V supply. −12.6VPP is derived from the −12.6V supply.

Refer to Figure 7 and carefully measure the power supply voltages at the front panel RF probe connectors.

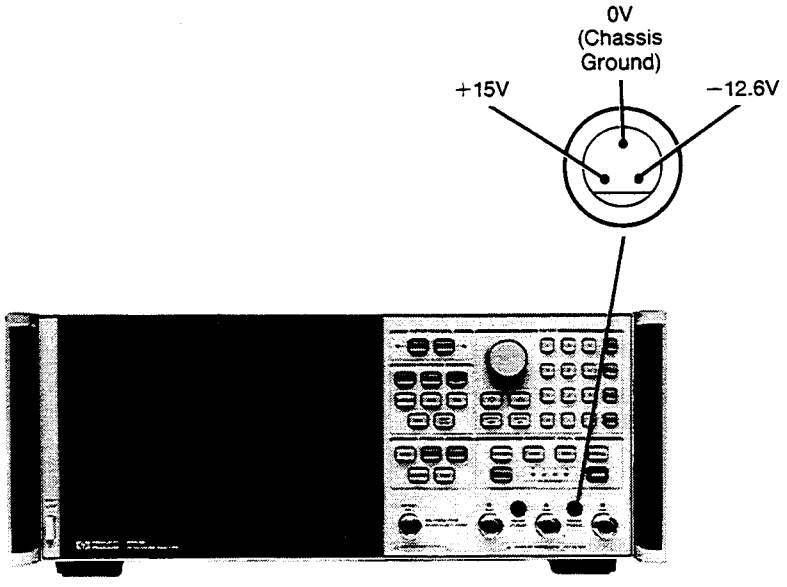


Figure 7. Front Panel Probe Power Connector Voltages

If the correct voltages are present, troubleshoot the probe.

If the voltages are not present, check the +15V and −12.6V green LEDs on A8.

- If the LEDs are on, there is an open between the A8 assembly and the front panel probe power connectors. Put A8 onto an extender board and measure the voltages at the following pins:

A8P2 pins 6 and 36	−12.6 volts
A8P2 pins 4 and 34	+15 volts

- If the LEDs are off, continue with the next paragraph.

Check Fuses and Isolate A8. Check the fuses associated with each of these supplies near the A8 test points. If these fuses keep burning out, a short exists. Try isolating A8 by removing it from the motherboard connector, but keeping the cable A15W1 connected to A8J2. Connect a jumper wire from A8TP3 (HP 8753A/B and 8702A) or A8TP2 (HP 8753C and 8702B) to chassis ground. If either the +15V or −12.6V fuse blows, or the associated A8 green LEDs do not light, replace A8.

- If the +15V and −12.6V green LEDs light, troubleshoot for a short between the motherboard connector pins XA8P2 pins 6 and 36 (−12.6V) and the front panel probe power connectors. Also check between motherboard connector pins XA8P2 pins 4 and 34 (+15V) and the front panel probe power connectors.

FAN TROUBLESHOOTING

Fan Speeds

The fan speed is continuously variable depending upon temperature. It is normal for the fan to be at high speed when the instrument is just turned on, and then change to low speed when the instrument is cooled.

Check the Fan Voltages

If the fan is dead, refer to the A8 post-regulator block diagram in Figure 18. The fan is driven by the +18V and −18V supplies coming from the A15 preregulator. Neither of these supplies is fused. The −18V supply is regulated on A8 in the fan drive block, and remains constant at approximately −14 volts. It connects to the A17 motherboard via pin 32 of the A8P1 connector.

The +18V supply is regulated on A8 but changes the voltage to the fan, depending on airflow and temperature information. Its voltage ranges from approximately −1.0 volts to +14.7 volts, and connects to the A17 motherboard via pin 31 of the A8P1 connector.

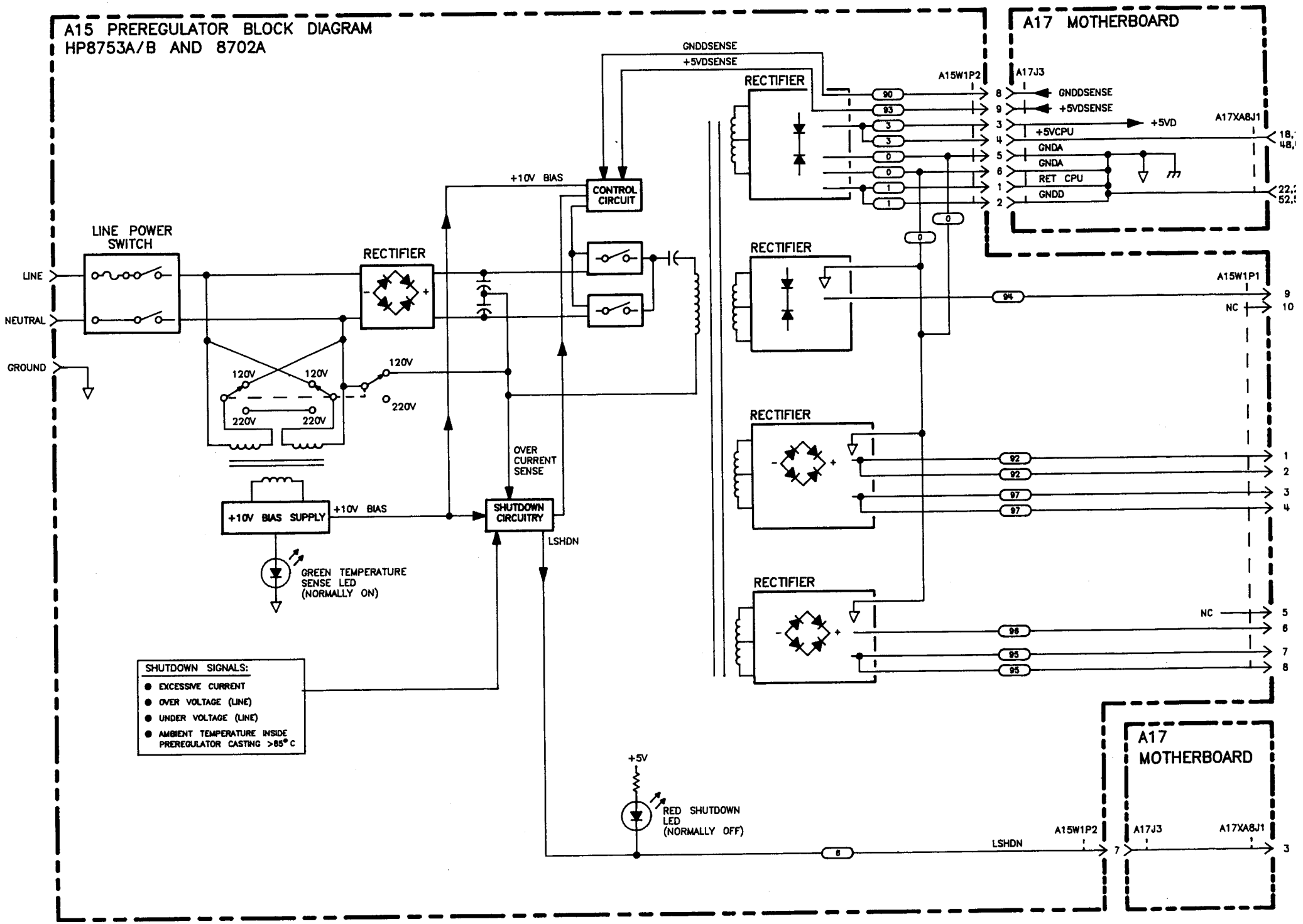
Short A8TP3 to Ground

If there is no voltage at A8P1 pins 31 and 32, turn the instrument off. Remove A8 from its motherboard connector but keep the cable A15W1 connected to A8. Connect a wire between A8TP3 and chassis ground. Turn the instrument on.

- If all the green LEDs on the top edge of A8 light (except +5VD), replace the fan.
- If other green LEDs on A8 do not light, refer to *Find Out Why the Green LEDs on A8 Are Not All On* earlier in this procedure.

INTERMITTENT PROBLEMS

PRESET states that appear spontaneously (without pressing **[PRESET]**) typically signal a power supply or A9 assembly problem. Since the A9 assembly is the easiest to substitute, do so. If the problem ceases, replace the A9. If the problem continues, replace the A15 preregulator assembly.


A15 PREREGULATOR BLOCK DIAGRAM
HP8753A/B AND 8702A
A17 MOTHERBOARD
GNDDSENSE
+5VDSENSE
A15W1P2
A17J3
RECTIFIER
90
93
3
3
0
0
1
1
8
9
3
4
5
6
1
2
GNDDSENSE
+5VDSENSE
+5VD
+5VCPU
GNDA
GNDA
RET CPU
GNDD
A17XA8J1
18,
48,
22,
52,
+10V BIAS
CONTROL CIRCUIT
LINE POWER SWITCH
LINE
NEUTRAL
GROUND
RECTIFIER
120V
120V
120V
220V
220V
220V
OVER CURRENT SENSE
+10V BIAS SUPPLY
+10V BIAS
SHUTDOWN CIRCUITRY
LSHDN
GREEN TEMPERATURE SENSE LED (NORMALLY ON)
SHUTDOWN SIGNALS:
EXCESSIVE CURRENT
OVER VOLTAGE (LINE)
UNDER VOLTAGE (LINE)
AMBIENT TEMPERATURE INSIDE PREREGULATOR CASTING >85° C
+5V
RED SHUTDOWN LED (NORMALLY OFF)
RECTIFIER
94
A15W1P1
9
NC
10
RECTIFIER
92
92
97
97
1
2
3
4
RECTIFIER
NC
5
98
6
95
95
7
8
A17 MOTHERBOARD
A15W1P2
LSHDN
8
7
A17J3
A17XA8J1
3

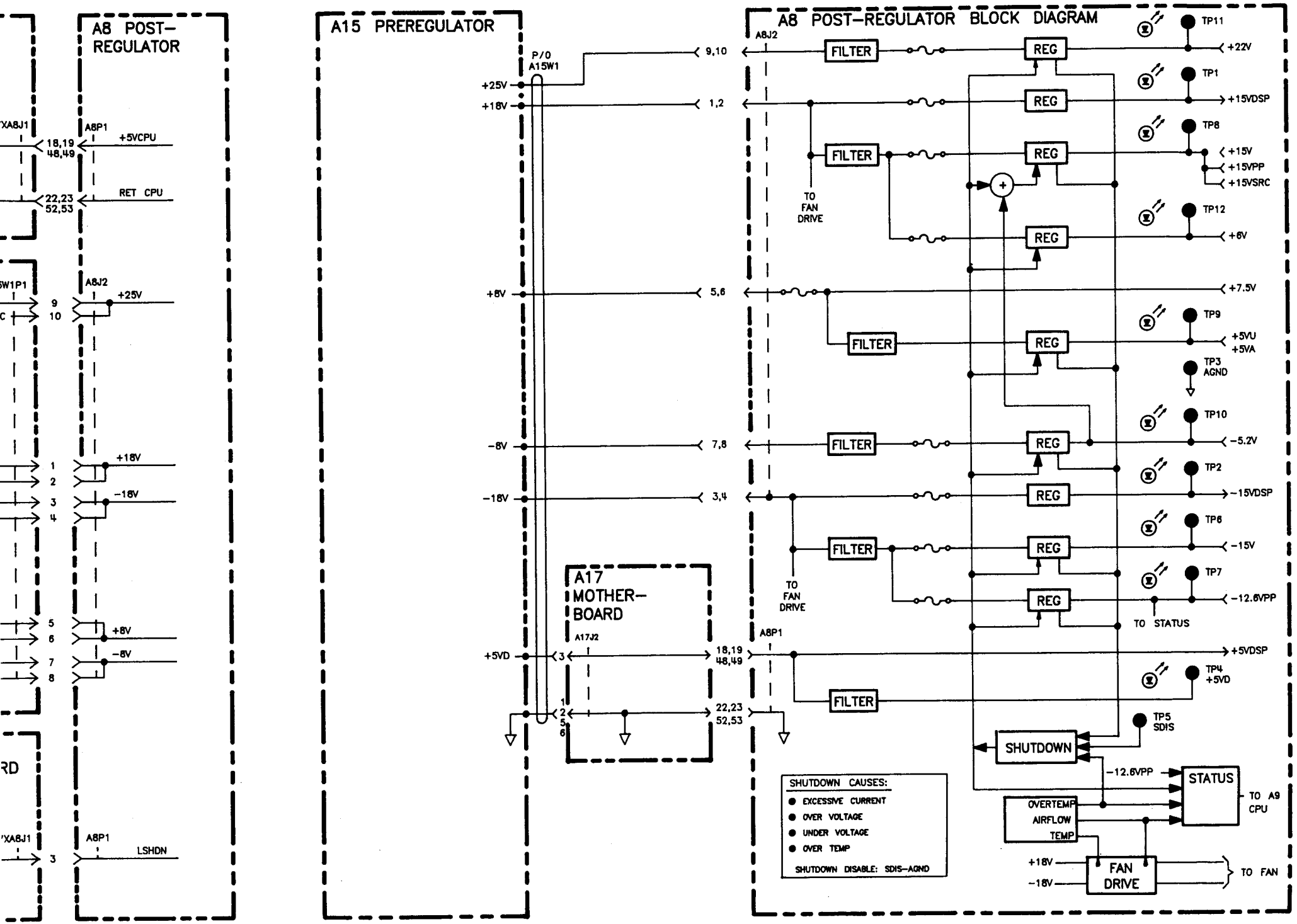
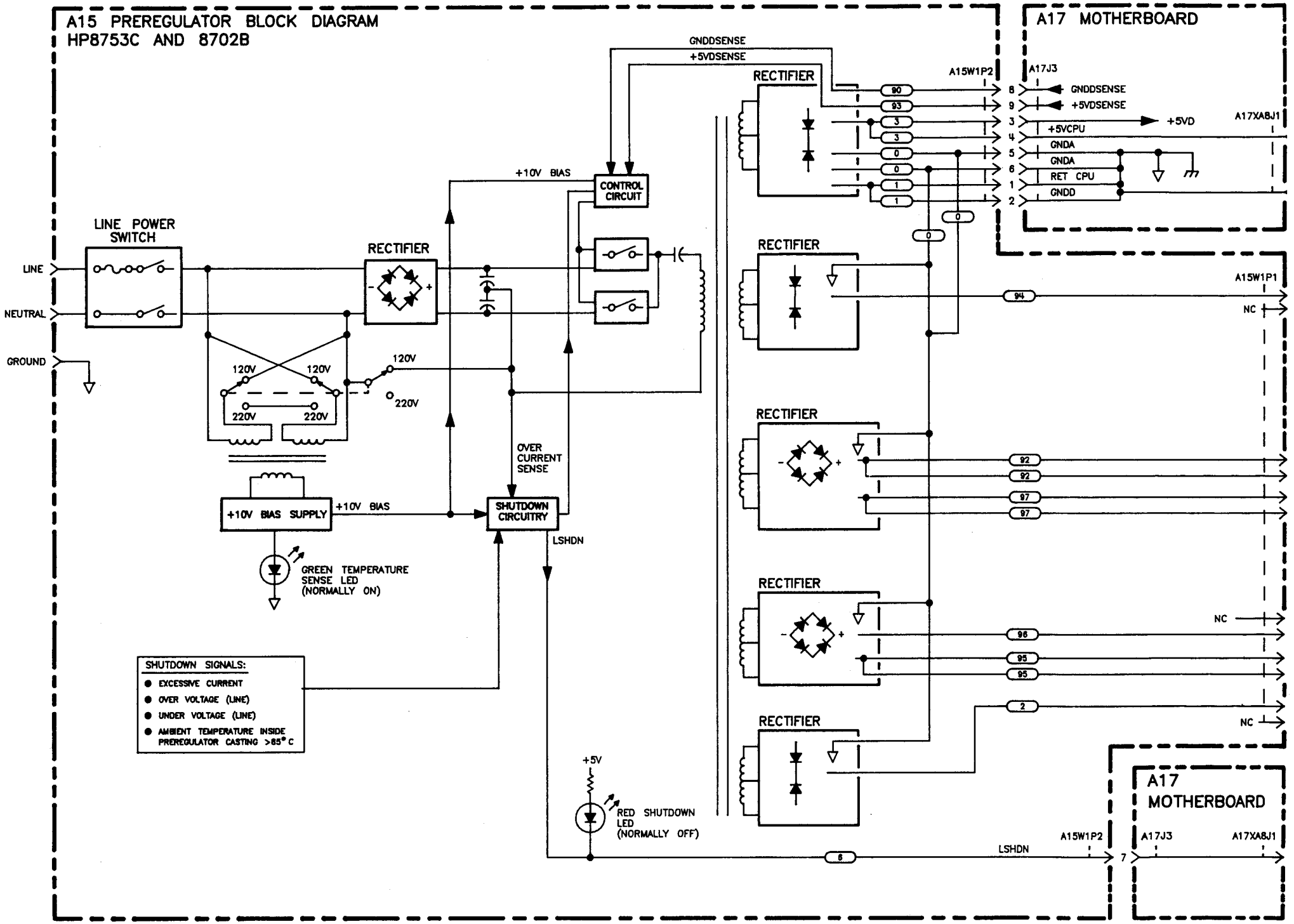


Figure 18a. Power Supply Block Diagram


A15 PREREGULATOR BLOCK DIAGRAM
HP8753C AND 8702B
A17 MOTHERBOARD
GNDDSENSE
+5VDSENSE
A15W1P2
A17J3
RECTIFIER
90
93
3
3
0
0
1
1
8 GNDDSENSE
9 +5VDSENSE
3 +5VD
4 +5VCPU
5 GNDA
6 GNDA
1 RET CPU
2 GNDD
A17XA8J1
+10V BIAS
CONTROL CIRCUIT
LINE POWER SWITCH
LINE
NEUTRAL
GROUND
RECTIFIER
120V
120V
120V
220V
220V
220V
OVER CURRENT SENSE
+10V BIAS SUPPLY
+10V BIAS
SHUTDOWN CIRCUITRY
LSHDN
GREEN TEMPERATURE SENSE LED (NORMALLY ON)
SHUTDOWN SIGNALS:
EXCESSIVE CURRENT
OVER VOLTAGE (LINE)
UNDER VOLTAGE (LINE)
AMBIENT TEMPERATURE INSIDE PREREGULATOR CASTING >85° C
+5V
RED SHUTDOWN LED (NORMALLY OFF)
A15W1P1
94
NC
92
92
97
97
96
95
95
2
NC
8
LSHDN
A15W1P2
7
A17 MOTHERBOARD
A17J3
A17XA8J1

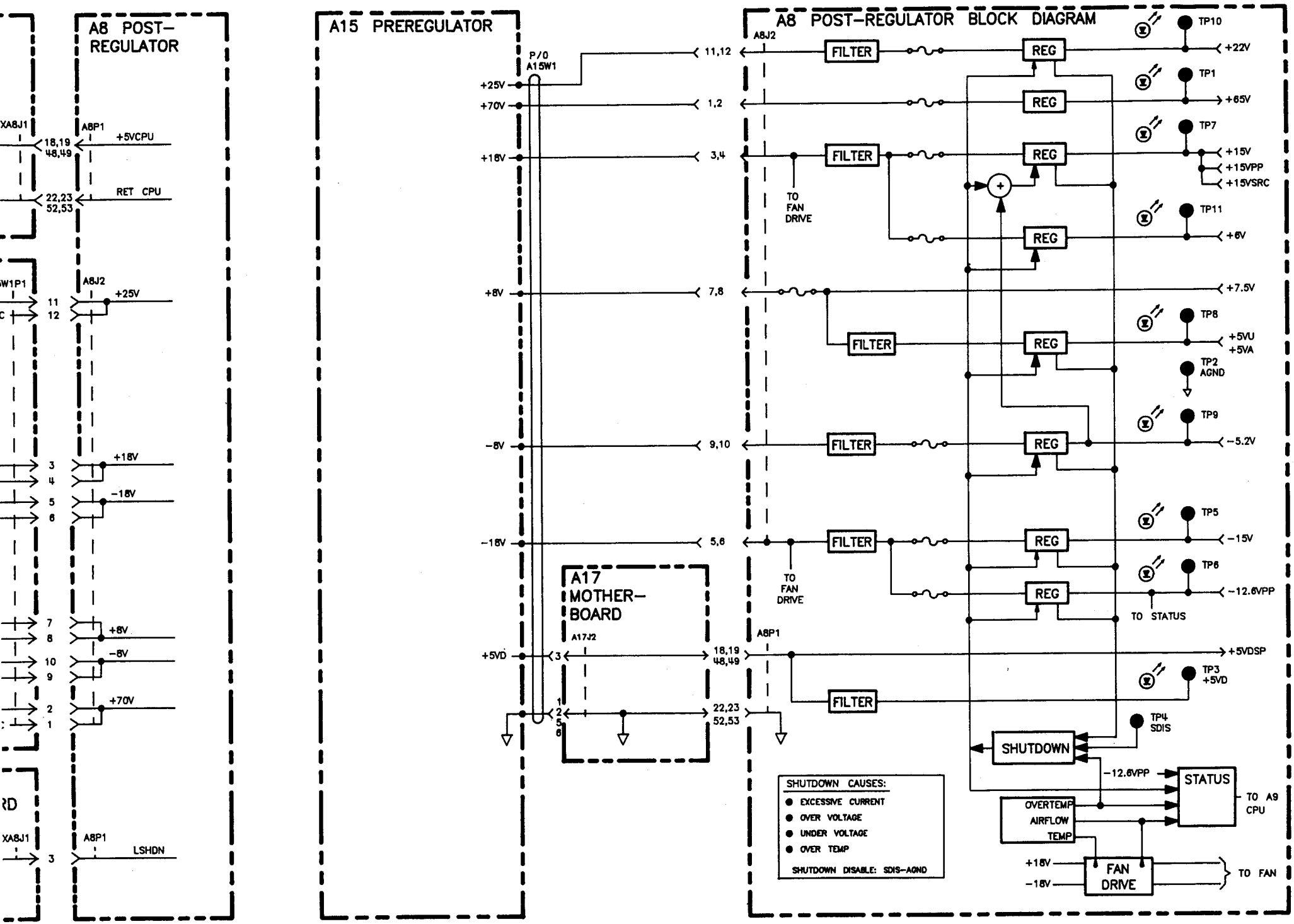


Figure 18b. Power Supply Block Diagram

REPAIR SEQUENCE

Troubleshooting: Identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

Use this procedure only if you have followed the procedures in the *Isolate Faulty Group* section, and believe the problem to be in the digital control group. The procedure is designed to let you identify the bad assembly within the digital control group in the shortest possible time. Whenever an assembly is replaced in this procedure, refer to the *Table of Related Service Procedures* in the *Post-Repair Procedures* section.

If you only want to troubleshoot HP-IB failures, go directly to *HP-IB Failures* at the end of this section.

NOTE: This troubleshooting section is divided into two parts. For the HP8753A/B and 8702A, begin with this page. For the HP 8753C and 8702B, skip ahead to *Part II. HP 8753C and 8702B,* on page 16.

PART I. HP 8753A/B AND 8702A

Figure 1 shows the digital control group in simplified block diagram form. The following assemblies make up the digital control group:

A1 front panel	A10 digital IF
A2 front panel processor	A16 rear panel
A9 CPU	A18 display

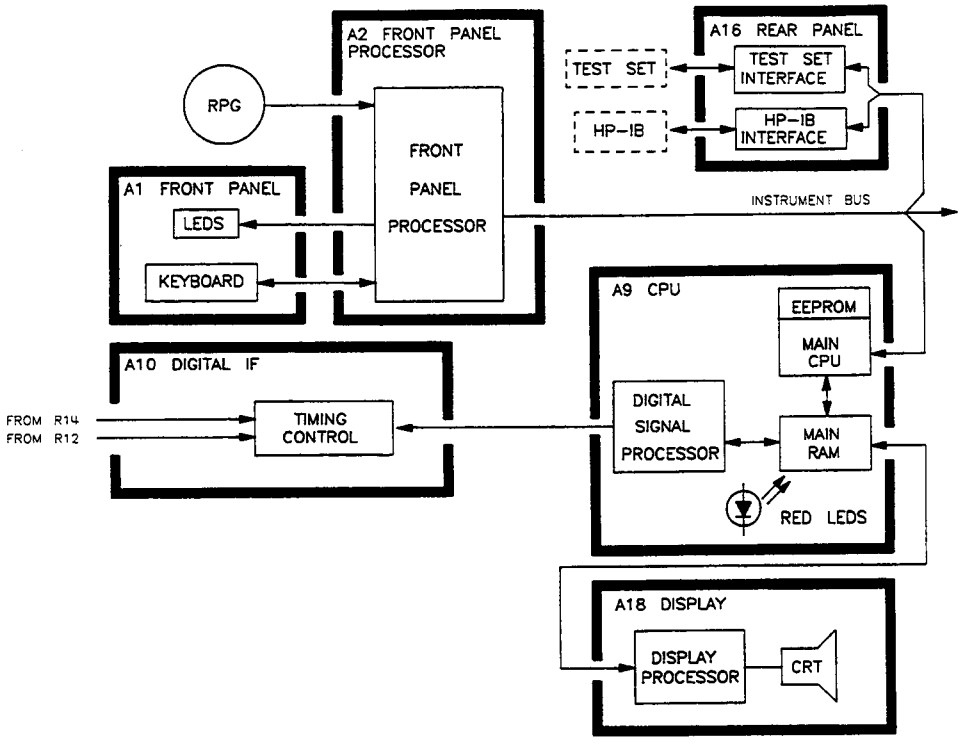


Figure 1. Digital Control Functional Group Block Diagram for the HP 8753A/B and 8702A

Table 1. Digital Control Troubleshooting Summary for the HP 8753A/B and 8702A

This summary gives an overview of the digital control group troubleshooting procedure. Technicians who are already familiar with troubleshooting the digital control group may save time by following this summary instead of reading the entire procedure. Headings in this summary match the headings in the procedure.

START HERE FOR THE HP 8753A/B AND 8702A

CHECK A9 CPU OPERATION

- Check LED Pattern With Preset Key Held in
- Check LED Pattern After Preset Key is Released

CHECK A18 DISPLAY OPERATION

- Cycle Power and Look at the Display

CHECK FRONT PANEL CONTROL

- Perform Preset and Watch the Front Panel LEDs
- Front Panel Error Codes Test

A1/A2 FRONT PANEL TROUBLESHOOTING

- Press [PRESET]
- All Front Panel LEDs Stay On
  - Inspect the Front Panel
  - Test Using a Controller
- Random Front Panel LED Pattern
  - Error Codes Test

RUN THE SELF TESTS AND OTHER DIAGNOSTIC TESTS

- Check Preset
- Internal Self Tests
- Internal Test 12
- External Tests

A18 DISPLAY TROUBLESHOOTING

- Check Display Power Supplies
- Check Display Test Pattern
- Check Front Panel Control of Display Focus and Intensity
  - Disconnect the Cable
  - Try Softkey Control
  - Measure the Cable Voltages
  - Check W16 and the RPG

IF THE FAULT IS INTERMITTENT

START HERE FOR THE HP 8753A/B AND 8702A

Follow the procedures in the order given, unless instructed otherwise. If an HP-IB interface problem is suspected, refer to *HP-IB Failures* at the end of this section.

CHECK A9 CPU OPERATION

NOTE: Be sure the A9CC jumper is in the "normal" position for these procedures.

Check LED Pattern With Preset Key Held In

Refer to Figure 2. Turn the analyzer on, press and hold the **[PRESET]** key. The A9 HALT LED on the far left end of the board should be on steadily and the other LEDs will be on or off randomly as shown in Figure 2a.

Check LED Pattern After Preset Key is Released

Release **[PRESET]**. The HALT LED should go out and the 1-2-4 LEDs should do a binary count from 1 to 6 in about one-half second. At the end of this sequence, the HALT LED should stay off and the other LEDs should appear as shown in Figure 2c. Note the results.

- If the LEDs end the sequence as shown in Figure 2c, the A9 CPU is working to a confidence level of 75%. Refer to *Check A18 Display Operation,* following.
- If the test fails, replace the firmware ICs if the CRT displays one of these messages:

  ROM 1M or 1L FAIL
  ROM 2M or 2L FAIL
  ROM 3M or 3L FAIL

  Firmware replacement kits are listed in the *Replaceable Parts* section.
- If the test fails and no FAIL messages are displayed, replace the A9 CPU assembly.

CHECK A18 DISPLAY OPERATION

Cycle Power and Look at the Display

Turn the analyzer off, and then on. The display should show a normal, clear graticule with character labels around it (Figure 3). Disregard any error messages if RF OUT is not connected to input R.

- If the display is normal, refer to *Check Front Panel Control.*
- If the display is not normal, refer to *A18 Display Troubleshooting* in this procedure.

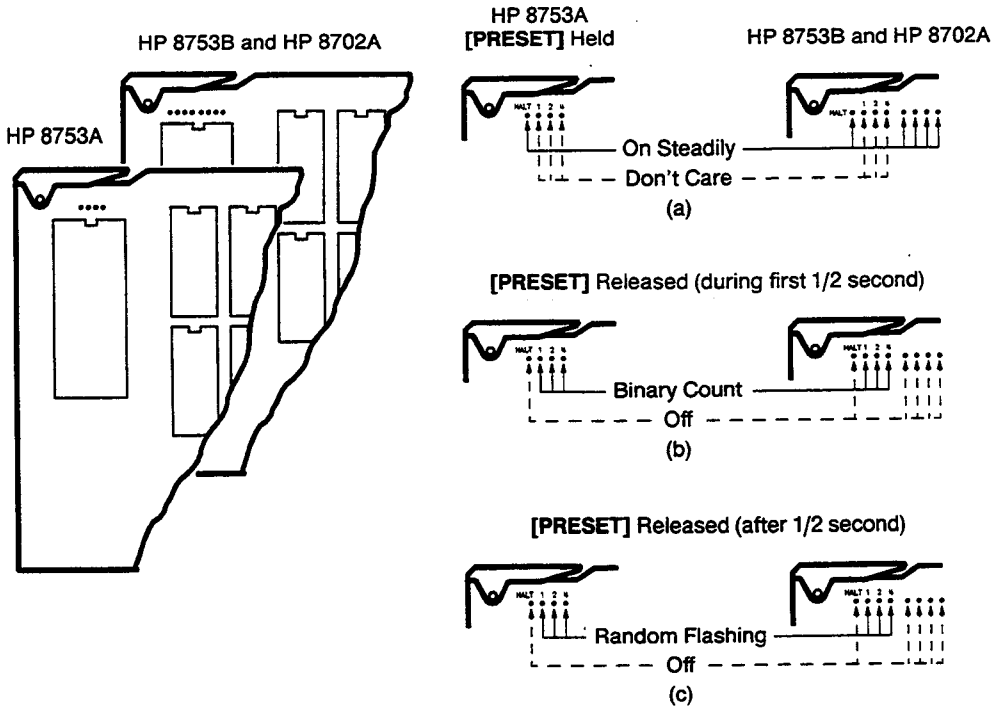


Figure 2. A9CPU Diagnostic LEDs

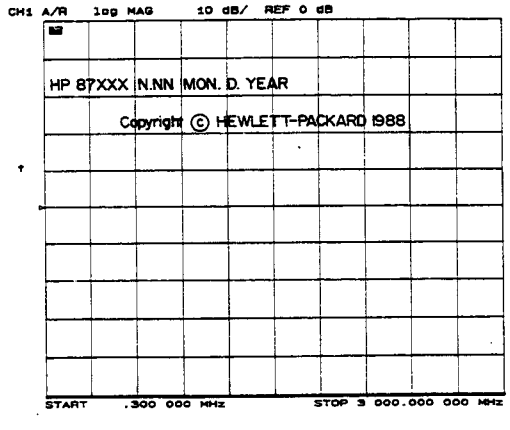


Figure 3. Display Graticule after Turn-on

CHECK FRONT PANEL CONTROL

Perform Preset and Watch the Front Panel LEDs

Press **[PRESET]**; all front panel LEDs should light. When **[PRESET]** is released, a subset of the internal diagnostic tests should run automatically. Within five seconds after the preset key is released, the **[CH 1]** LED should stay on and all other LEDs on the front panel should go off.

Press **[CH 2]** and then press **[CH 1]**. The amber LEDs next to each of these keys should light when each key is pressed.

- If the **[CH 1]** and **[CH 2]** LEDs respond correctly, refer to *Run the Self Tests and Other Diagnostic Tests.*
- If the LEDs do not light when the corresponding keys are pressed, the problem may be in one of the A1 front panel keys, or in the A2 front panel processor assembly. Continue with *Front Panel Error Codes Test,* next.

Front Panel Error Codes Test

Verify the A1/A2 assemblies by continuing with the *Front Panel Error Codes Test.* This check allows the user to exercise the front panel microprocessor by isolating the front panel from the main microprocessor (CPU) on the A9 CPU board assembly, and from the instrument bus. A unique code is generated for each front panel key pressed by lighting the six amber LEDs located on the front panel. The A9 CPU assembly may be removed without affecting this check.

To initiate the check, press **[PRESET]** and any other front panel key at the same time. Release the **[PRESET]** key first, and then the other key.

Each front panel key should be pressed, beginning with the top softkey (follow the sequence of keys listed in Table 2). As this is done, a code will be generated that is unique to each key. the code is displayed by lighting a specific pattern of LEDs on the front panel (CH 1, CH 2, and R L T S). Refer to Table 2, which shows all front panel keys and their related codes. • denotes a lit LED.

To exit the check, press **[PRESET]**.

- If the Front Panel Error Codes test fails, the A1 front panel or the A2 front panel processor is bad. Continue with *A1/A2 Front Panel Troubleshooting.*
- If the Front Panel Error Codes test passes, the digital control group is 50% confirmed. Refer to *Run the Self Tests and Other Diagnostic Tests*.

Table 2. Front Panel Key Codes

Decimal Number	LED Pattern CH1	CH2	R	L	T	S	Key	Front Panel Block
0							CAL	Response
1						●	3	Entry
2					●		k/m	Entry
3					●	●	DISPLAY	Response
4				●			AVG	Response
5				●		●	2	Entry
6				●	●		1	Entry
7				●	●	●	3	Softkey
8			●				5	Softkey
9			●			●	9	Entry
10			●		●		G/n	Entry
11			●		●	●	CH 1	Active Channel
12			●	●			CH 2	Active Channel
13			●	●		●	8	Entry
14			●	●	●		7	Entry
15			●	●	●	●	1	Softkey
16		●					STOP	Stimulus
17		●				●	SAVE	Instrument State
18		●			●		RECALL	Instrument State
19		●			●	●	MENU	Stimulus
20		●		●			START	Stimulus
21		●		●		●	COPY	Instrument State
22		●		●	●		SYSTEM	Instrument State
23		●		●	●	●	6	Softkey
24		●	●				SCALE REF	Response
25		●	●			●	6	Entry
26		●	●		●		M/u	Entry
27		●	●		●	●	MEAS	Response
28		●	●	●			FORMAT	Response
29		●	●	●		●	5	Entry
30		●	●	●	●		4	Entry
31		●	●	●	●	●	2	Softkey
32	●						SPAN	Stimulus
33	●					●	▼	Entry
34	●				●		ENTRY OFF	Entry
35	●				●	●	CENTER	Stimulus
36	●			●			8	Softkey
37	●			●		●	▲	Entry
38	●			●	●		LOCAL	Instrument State
39	●			●	●	●	7	Softkey
40-47	Not used							
48	●	●					BACK SP	Entry
49	●	●				●	–	Entry
50	●	●			●		x1	Entry
51	●	●			●	●	MKR	Response
52	●	●		●			MKR FCTN	Response
53	●	●		●		●	.	Entry
54	●	●		●	●		0	Entry
55	●	●		●	●	●	4	Softkey

A1/A2 FRONT PANEL TROUBLESHOOTING

The A1 front panel assembly is separate from the the A2 front panel processor assembly, even though both assemblies connect together like a single unit. The A1 assembly contains mostly pushbutton switches. The A2 assembly communicates with the A9 CPU via the internal bus with its own microprocessor.

When troubleshooting an error in the front panel assemblies, a fault of a single control function or key indicates that A1 is bad. No control from any front panel keys indicates that A2 is bad.

Press [PRESET]

Press **[PRESET]** and observe the front panel LEDs.

- If all the LEDs stay on, refer to *All Front Panel LEDs Stay On*.
- If the LEDs display a random pattern, refer to *Random Front Panel LED Pattern.*

All Front Panel LEDs Stay On

If all front panel LEDs stay on, the A9 CPU and A1/A2 front panel are not communicating with each other. There is no front panel control.

Inspect the Front Panel. Remove the A1/A2 front panel and visually inspect the ribbon cable that connects the front panel to the motherboard. Also inspect the interconnecting ribbon cable between A1 and A2. Make sure the cables are properly connected. Replace any cables that appear bad.

Test Using a Controller. If a controller is available, try to write a simple instruction to the analyzer. If it can be controlled, the problem is probably on A1/A2, or the ribbon cable connecting A1/A2 to the motherboard may be loose.

Random Front Panel LED Pattern

A random front panel LED pattern after preset means there may be a stuck key on A1. This would cause the instrument to enter the Front Panel Error Codes test.

Error Codes Test. This test verifies each front panel key by turning on a unique pattern of front panel LEDs for every key pressed. To find which key is stuck, refer back to *Front Panel Error Codes Test*.

Match the LED pattern on the instrument front panel with the same pattern shown in the Front Panel Error Codes Truth Table. The key that corresponds to that pattern is probably stuck on. This prevents the other keys (except **[PRESET]**) from working.

Remove the A1 front panel and replace it. Refer to the *Replaceable Parts* section of this manual for the HP part number of the front panel.

RUN THE SELF TESTS AND OTHER DIAGNOSTIC TESTS

When scrolling through diagnostic tests in the following check, one of the following messages will appear after each test. Their meanings are:

IP	test in progress (not completed)
ND	test not done (not run)
PASS	test sucessfully completed
FAIL	test did not pass when run

- If any diagnostic test shows **IP** (in progress), some fault will not allow the test to complete.

Check Preset

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** and see if instrument preset has passed.

- If preset passes, the message "PRESET PASS" will appear on the display. Continue with *Internal Self Tests*.
- If preset fails, press **[RETURN] [SELF DIAGNOSE]** to see which assembly might have failed. You may use the RPG or the [▲] or [▼] keys to scroll through the tests and find the first one that failed. There may be more than one test that failed, but the first is the most significant.

Refer to *Test Descriptions* in the *Service Key Menus* section in this manual for an explanation of the test that failed. Make note of the assembly or assemblies involved in the test and continue with this procedure.

Internal Self Tests

After instrument preset has passed, press **[0] [x1]** ***[EXECUTE TEST]*** to run the ALL INT self tests. These 15 tests take one second to run.

- If ALL INT self tests pass, the message "SELF TEST PASSED" will appear on the display. Refer to "Internal Test 12," which checks one internal test that is not included in self test.
- If ALL INT self tests fail, press ***[RETURN] [SELF DIAGNOSE]*** to see which assembly might have failed. You may use the RPG or the [▲] or [▼] keys to scroll through the tests and find the first one that failed.

See Table 3 for further troubleshooting information. Make note of the assembly or assemblies involved in the test and continue with this procedure.

Table 3. Internal Diagnostic Tests with Commentary

Test	Sequence[1]	Probable Failed Assembly[2]: Comments and Troubleshooting Hints
0 All Int	---	--: Executes tests 3-11, 13-16, 20.
1 Preset	---	--: Executes tests 2-11, 14-16. Runs at power-on or preset.
2 ROM	P	A9: Repeats on fail; refer to Table 1 to replace ROM or A9.
3 CMOS RAM	P,AI	A9: Replace A9.
4 Main DRAM	P,AI	A9: Repeats on fail; replace A9.
5 DSP Wr/Rd	P,AI	A9: Replace A9.
6 DSP RAM	P,AI	A9: Replace A9.
7 DSP ALU	P,AI	A9: Replace A9.
8 DSP Intrpt	P,AI	A9/A10: Remove A10, rerun test. If fail, replace A9. If pass, replace A10.
9 DIF Control	P,AI	A9/A10: Most likely A9 assembly.
10 DIF Counter	P,AI	A10/A9/A12: Check analog bus node 17 for 1 MHz. If correct, A12 is verified; suspect A10.
11 DSP Control	P,AI	A10/A9: Most likely A10.
12 Fr Pan Wr/Rd	---	A2/A1/A9: Run test 23. If fail, replace A2. If pass, problem is on bus between A9 and A2 or on A9 assembly.
13 Rear Panel	AI	A16/A9: Disconnect A16, and check A9J2 pin 48 for 4 MHz clock signal. If OK, replace A16. If not, replace A9.
14 Post-reg	P,AI	A15/A8/Destination assembly: See ***Power Supply*** section.
15 Frac-N Cont	P,AI	A14: Replace A14.
16 Sweep Trig	P,AI	A14,A10: Most likely A14.
17 ADC Lin	---	A10: Replace A10.
18 ADC Ofs	---	A10: Replace A10.
19 ABUS Test	---	A10: Replace A10.
20 FN Count	AI	A14/A13/A10: Most likely A14 or A13, as previous tests check A10. See *Source* section to troubleshoot.

1 P = part of PRESET sequence; AI =part of ALL INTERNAL sequence.
2 in decreasing order of probability.

Internal Test 12

Run internal test 12 (Front Panel Read/Write) now. Use the keystrokes outlined in *Internal Self Tests,* above.

- If this test passes, the digital control group works to a 90% level of confidence. Refer to *Isolate Faulty Group Troubleshooting* to determine a functional group that is more likely to have the problem. Try the self diagnose feature to help determine the failed assembly.
- If test 12 fails, refer to "External Tests," next.

External Tests

In addition to internal self tests, there are six external self tests (numbers 21 through 26). These tests require user interaction, with instructions given on the display. Only two of these external tests need to be performed. Both help to check the A1/A2 and A9 assemblies. They are test numbers:

23 Front Panel Sequence
24 Front Panel Diagnose

Perform these tests now using the keystokes in *Internal Self Tests* above.

- If these tests pass, there may be a problem on the internal bus between the A2 front panel processor and A9 CPU.
- If either test fails, there is probably a unique failure of either A1 or A2.

A18 DISPLAY TROUBLESHOOTING

- If the display is blank, continue with *Check Display Power Supplies,* below.
- If the display shows abnormal characters, patterns, etc. but has reasonable intensity and focus, go on to *Check Display Test Pattern.*

Check Display Power Supplies

Make sure the power supply voltages to the A18 display assembly are correct by measuring them on the PC board assembly on the top of the display. See Figure 4.

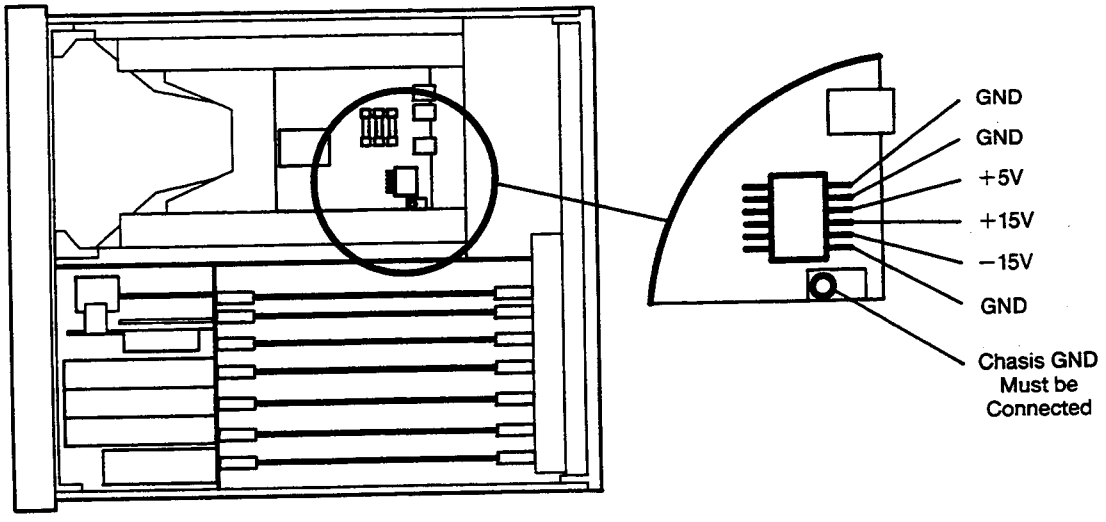


Figure 4. A18 Display Voltages

- If these voltages are bad, stop this procedure and go back to *Power Supply Troubleshooting.*
- If the voltages are correct, continue with *Check Display Test Pattern,* next.

Check Display Test Pattern

Turn off the analyzer. Remove the PC board retainer and the A9 CPU assembly. Turn the instrument on. The A18 display should show a test pattern identical to the one shown in Figure 5.

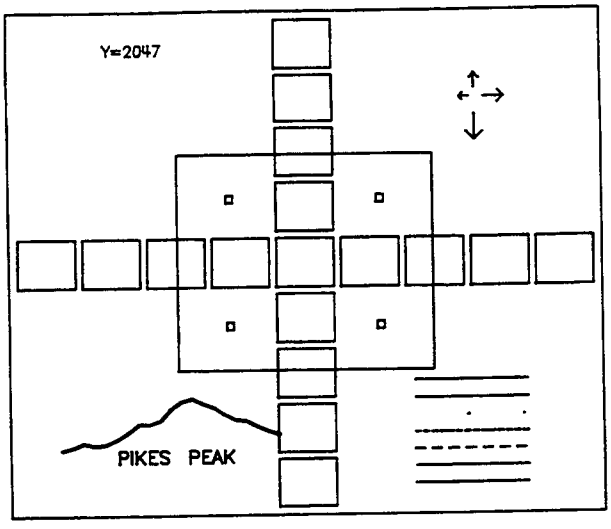


Figure 5. Display Test Pattern

This test pattern is generated by the display when the A9 CPU assembly is removed. This isolates the A18 display from the rest of the instrument, except for intensity and focus control by the front panel.

- If the display is normal, the two digital-to-analog converters on A2 that provide intensity and focus control for the display may be bad. Refer to *A1/A2 Front Panel Troubleshooting* in this procedure.
- If the display is still blank, or the test pattern matches Figure 5 but the intensity or focus is out of adjustment, turn the instrument off. Perform the Display Intensity and Focus Correction Constants routine in the *Adjustments* section of this manual.
- If the intensity or focus correction constants cannot be set, continue with this procedure.

Check Front Panel Control of Display Focus and Intensity

Disconnect the Cable. Turn the instrument off and remove the bottom cover. Refer to the cable location diagram in Figure 7 and disconnect the intensity/focus control cable from the display X-Y-Z analog assembly.

Try Softkey Control. Turn the instrument on and press **[DISPLAY]**. Press softkeys ***[MORE]*** and ***[INTENSITY]***. These are indicated in Figure 6. You may or may not be able to see the softkey labels.

Measure the Cable Voltages. With a voltmeter, measure the DC voltages on the cable carrying the intensity and focus signals to the display. Vary the RPG one revolution clockwise and one revolution counterclockwise, and compare the measured voltages with the typical values in Figure 7.

- If the voltages are correct, the A18 display assembly is bad. Refer to *Replaceable Parts* to order a replacement CRT (or its manual to repair it).
- If the control cable voltages are bad, the A18 display is probably good and the fault is in the intensity/focus cable, the RPG, or the A1/A2 front panel assemblies. Continue this procedure.

Check W16 and the RPG. Use the following troubleshooting hints and then repair or replace the faulty part or assembly.

The intensity/focus cable W16 can be checked with an ohmmeter.

The RPG can be verified by pressing the [▲] and [▼] step keys and noting whether or not they allow similar control. You can also look at the RPG output pulses with an oscilloscope.

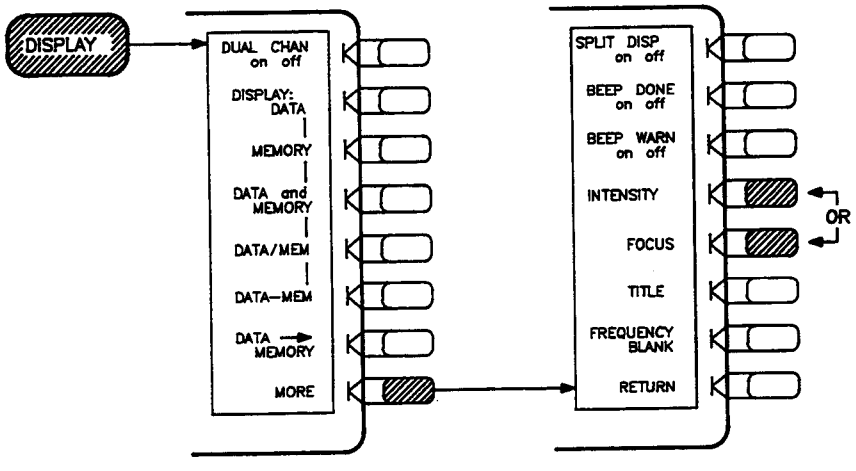
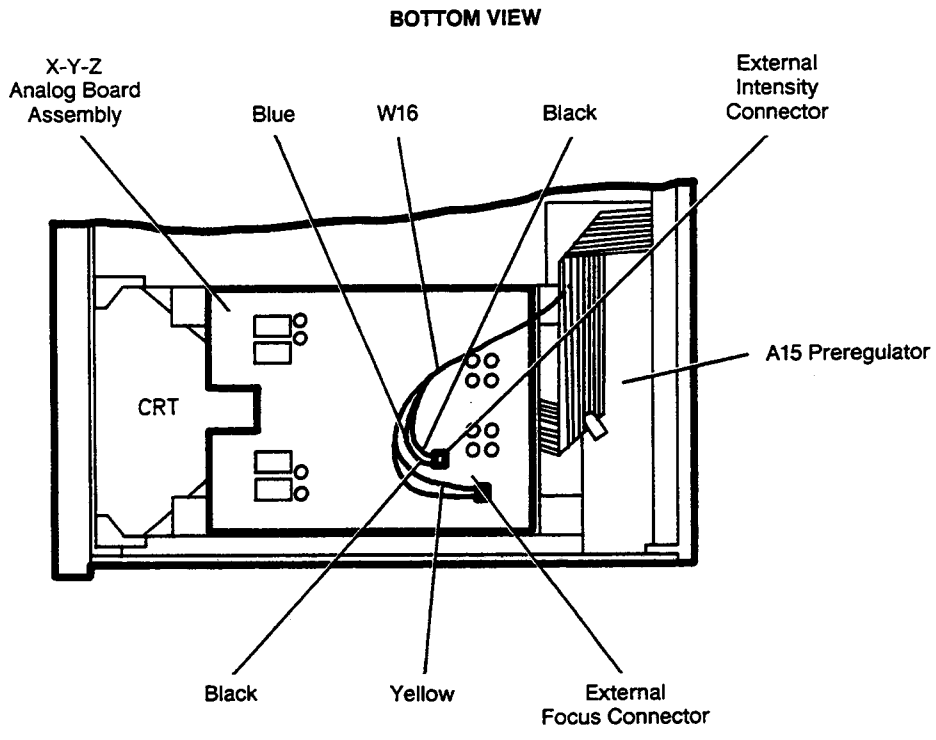


Figure 6. Display Softkey Sequence



DC voltages on W16 focus/intensity cable (W16 is disconnected from the X-Y-Z analog display assembly).

Wire Pair	Adjustment Range (Nominal Voltages)	
	Minimum	Maximum
Blue & Black (intensity)	0V	1V
Yellow & Black (focus)	0.4V	13.7V

Figure 7. Display Intensity/Focus Control Cable

IF THE FAULT IS INTERMITTENT

Repeat Test Function

If the failure is intermittent, press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [REPEAT ON] [RETURN] [TESTS]*** to turn on the repeat function. Then select the test desired and press ***[EXECUTE TEST]***. Press any key to stop the function. The test repeat function is explained in detail under *Test Options Menu* in the *Service Key Menus*.

PART II. HP 8753C AND 8702B

Note: This is the second part of the *Digital Control Troubleshooting* section. For the HP 8753A/B and 8702A, refer back to part I.

Figure 8 shows the digital control group in simplified block diagram form. The following assemblies make up the digital control group:

- A1 front panel
- A2 front panel interface
- A9 CPU
- A10 digital IF
- A16 rear panel
- A18 display
- A19 GSP

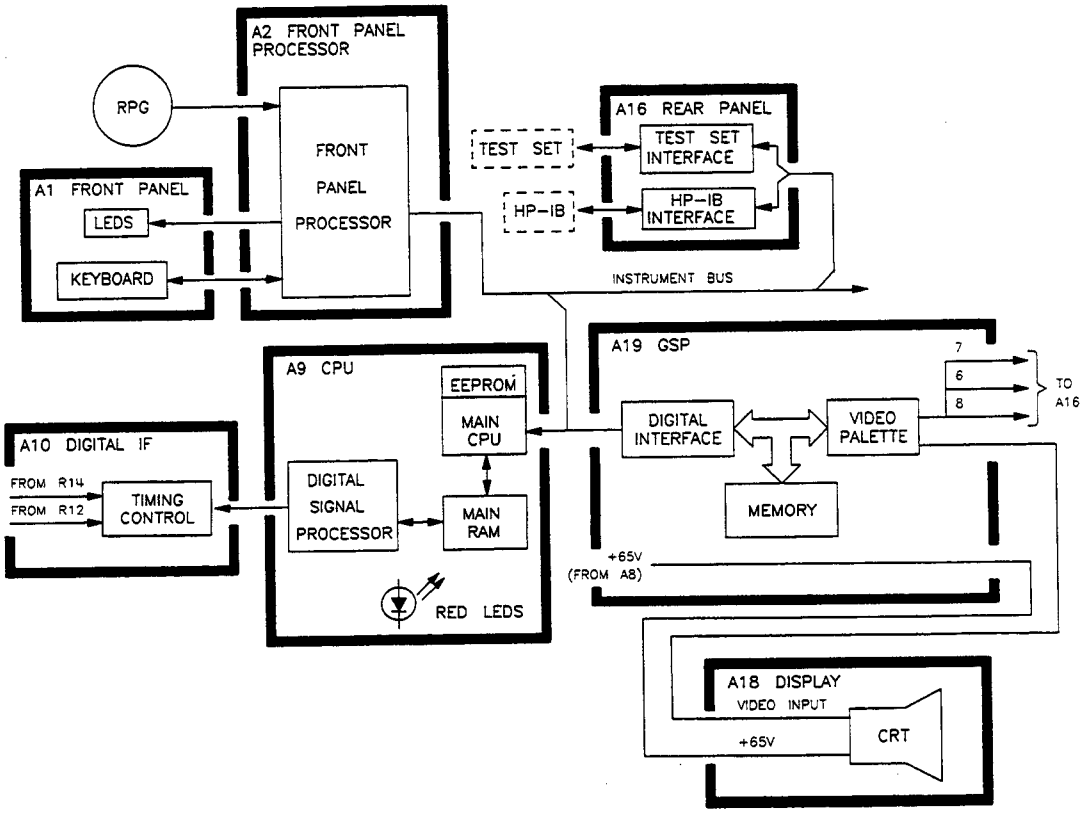


Figure 8. Digital Control Functional Group Block Diagram for the HP 8753C and 8702B

Table 4. Digital Control Troubleshooting Summary for the HP 8753C and 8702B

This summary gives an overview of the digital control group troubleshooting procedure. Technicians who are already familiar with troubleshooting the digital control group may save time by following this summary instead of reading the entire procedure. Headings in this summary match the headings in the procedure.

START HERE FOR THE HP 8753C AND 8702B

CHECK A9 CPU OPERATION

- Check LED Pattern After Cycling Power
- Check LED Pattern With Preset Key Held In
- Check LED Pattern After Preset Key Is Released

CHECK A19 GSP AND A18 DISPLAY OPERATION

- Cycle Power and Look at the Display
- Perform Display Intensity and Focus Adjustments

A1/A2 FRONT PANEL TROUBLESHOOTING

- Check Front Panel LEDs After Preset
- Identify Stuck Key
- Inspect Cables
- Test Using a Controller

RUN THE INTERNAL DIAGNOSTIC TESTS

A19 GSP AND A18 DISPLAY TROUBLESHOOTING

- Measure Display Power Supply Voltages on A19
- Measure Display Power Supply Voltages Entering A19
- Run Display Test 58
- Inspect Ribbon Cable and Repeat Display Test 58
- Perform Walking One Pattern
- Run Display Tests 59-64

IF THE FAULT IS INTERMITTENT

- Repeat Test Function

START HERE FOR THE HP 8753C AND 8702B

Follow the procedures in the order given, unless instructed otherwise. If an HP-IB interface problem is suspected, refer to *HP-IB Failures* at the end of this section.

CHECK A9 CPU OPERATION

Note: Be sure the A9CC jumper is in the "normal" position for these procedures.

Check LED Pattern After Cycling Power

Cycle the power on the analyzer and observe the four red LEDs (labeled RUN-1-2-4) on the top edge of the A9 CPU board. The R (RUN)LED should be on after the instrument is powered up.

If the R LED is not on, replace the A9 CPU after verifying the power supply.

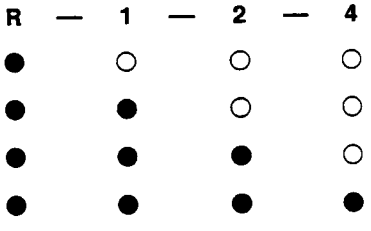
Check LED Pattern With Preset Key Held In

Press and hold down the **[PRESET]** key while observing the four LEDs on A9. The R LED should be off, and the 1-2-4 LEDs should stay in a fixed, random pattern.

Check LED Pattern After Preset Key is Released

Release the **[PRESET]** key and watch for the following sequence:

1. The run LED turns on.
2. The 1-2-4 LEDs perform a rapid count as shown below.



3. The run LED remains on.
4. The 1-2-4 LEDs flash randomly.

If this sequence is observed, go to *A19 GSP and A18 Display Operation*.

If the R LED does not remain on, and the A9CC jumper is in the "normal" position, replace the A9 CPU assembly and repeat the three LED pattern checks.

If the R LED remains on but the 1-2-4 LEDs are held in any of the patterns in Table 5, and the A9CC jumper is in "normal" position, replace the A9 firmware ICs. (Firmware ICs are not separately replaceable. Replacement kits are listed in the *Replaceable Parts* section.)

Table 5. LED Code and Pattern Versus Test Failed

LED Code Sum	Message Displayed on CRT	Faulty Component
R 1 2 4 ● ● ○ ○	ROM IL FAIL	U24
● ● ○ ○	ROM IM FAIL	U4
● ● ● ○	ROM 2L FAIL	U25
● ● ● ○	ROM 2M FAIL	U5

CHECK A19 GSP AND A18 DISPLAY OPERATION

Cycle Power and Look at the Display

Turn the analyzer off, and then on. The display should be bright and focused with the annotation legible and intelligible.

If the display is acceptable, go to *A1/A2 Front Panel Troubleshooting*.

If the display is unacceptable, continue with the next check.

Perform Display Intensity and Focus Adjustments

In the *Adjustments* section, perform the display intensity and focus adjustments. If this does not resolve the problem, refer to *A19 GSP and A18 Display Troubleshooting*.

A1/A2 FRONT PANEL TROUBLESHOOTING

Check Front Panel LEDs After Preset

Press **[PRESET]** on the analyzer. Observe that all front panel LEDs turn on and, within five seconds after release, all but the CH1 LED turns off.

If all the front panel LEDs either stay on or off, there is a control problem between A9 and A1/A2. See *Inspect Cables*.

If the LEDs are random (neither all on nor all off), continue with *Identify Stuck Key*.

Identify Stuck Key

Match the LED pattern with the patterns in Table 6. The LED pattern identifies the stuck key. Free the stuck key or replace the A1 front panel.

Table 6. Front Panel Key Codes

Decimal Number	LED Pattern CH1	CH2	R	L	T	S	Key	Front Panel Block
0							CAL	Response
1						●	3	Entry
2					●		k/m	Entry
3					●	●	DISPLAY	Response
4				●			AVG	Response
5				●		●	2	Entry
6				●	●		1	Entry
7				●	●	●	3	Softkey
8			●				5	Softkey
9			●			●	9	Entry
10			●		●		G/n	Entry
11			●		●	●	CH 1	Active Channel
12			●	●			CH 2	Active Channel
13			●	●		●	8	Entry
14			●	●	●		7	Entry
15			●	●	●	●	1	Softkey
16		●					STOP	Stimulus
17		●				●	SAVE	Instrument State
18		●			●		RECALL	Instrument State
19		●			●	●	MENU	Stimulus
20		●		●			START	Stimulus
21		●		●		●	COPY	Instrument State
22		●		●	●		SYSTEM	Instrument State
23		●		●	●	●	6	Softkey
24		●	●				SCALE REF	Response
25		●	●			●	6	Entry
26		●	●		●		M/u	Entry
27		●	●		●	●	MEAS	Response
28		●	●	●			FORMAT	Response
29		●	●	●		●	5	Entry
30		●	●	●	●		4	Entry
31		●	●	●	●	●	2	Softkey
32	●						SPAN	Stimulus
33	●					●	▼	Entry
34	●				●		ENTRY OFF	Entry
35	●				●	●	CENTER	Stimulus
36	●			●			8	Softkey
37	●			●		●	▲	Entry
38	●			●	●		LOCAL	Instrument State
39	●			●	●	●	7	Softkey
40-47	Not used							
48	●	●					BACK SP	Entry
49	●	●				●	–	Entry
50	●	●			●		x1	Entry
51	●	●			●	●	MKR	Response
52	●	●		●			MKR FCTN	Response
53	●	●		●		●	.	Entry
54	●	●		●	●		0	Entry
55	●	●		●	●	●	4	Softkey

Inspect Cables

Remove the A1/A2 front panel and visually inspect the ribbon cable that connects the front panel to the motherboard. Also, inspect the interconnecting ribbon cable between A1 and A2. Make sure the cables are properly connected. Replace any bad cables.

Test Using a Controller

If a controller is available, write a simple command to the analyzer. If the analyzer successfully implements the command, the problem is either the A2 or a faulty A1/A2 ribbon cable to the motherboard connection.

RUN THE INTERNAL DIAGNOSTIC TESTS

The analyzer incorporates 20 internal diagnostic tests. Most tests can be run as part of one or both major test sequences: all internal (test 0) and preset (test 1). Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[0] [x1]** ***[EXECUTE TEST]*** to perform All INT tests. Then press **[1] [x1]** to see the results of the preset test. If either sequence fails, press the [▲] [▼] keys to find the first occurrence of a FAIL message for tests 2 through 20. See Table 7 for further troubleshooting information.

Table 7. Internal Diagnostic Tests with Commentary

Test	Sequence[1]	Probable Failed Assembly[2]: Comments and Troubleshooting Hints
0 All Int	---	--: Executes tests 3-11, 13-16, 20.
1 Preset	---	--: Executes tests 2-11, 14-16. Runs at power-on or preset.
2 ROM	P	A9: Repeats on fail; refer to Table 1 to replace ROM or A9.
3 CMOS RAM	P,AI	A9: Replace A9.
4 Main DRAM	P,AI	A9: Repeats on fail; replace A9.
5 DSP Wr/Rd	P,AI	A9: Replace A9.
6 DSP RAM	P,AI	A9: Replace A9.
7 DSP ALU	P,AI	A9: Replace A9.
8 DSP Intrpt	P,AI	A9/A10: Remove A10, rerun test. If fail, replace A9. If pass, replace A10.
9 DIF Control	P,AI	A9/A10: Most likely A9 assembly.
10 DIF Counter	P,AI	A10/A9/A12: Check analog bus node 17 for 1 MHz. If correct, A12 is verified; suspect A10.
11 DSP Control	P,AI	A10/A9: Most likely A10.
12 Fr Pan Wr/Rd	---	A2/A1/A9: Run test 23. If fail, replace A2. If pass, problem is on bus between A9 and A2 or on A9 assembly.
13 Rear Panel	AI	A16/A9: Disconnect A16, and check A9J2 pin 48 for 4 MHz clock signal. If OK, replace A16. If not, replace A9.
14 Post-reg	P,AI	A15/A8/Destination assembly: See ***Power Supply*** section.
15 Frac-N Cont	P,AI	A14: Replace A14.
16 Sweep Trig	P,AI	A14,A10: Most likely A14.
17 ADC Lin	---	A10: Replace A10.
18 ADC Ofs	---	A10: Replace A10.
19 ABUS Test	---	A10: Replace A10.
20 FN Count	AI	A14/A13/A10: Most likely A14 or A13, as previous tests check A10. See *Source* section to troubleshoot.

1 P = part of PRESET sequence; AI = part of ALL INTERNAL sequence.
2 in decreasing order of probability.

Measure Display Power Supply Voltages on A19

Measure the display power supply voltages on the A19 GSP assembly. Check pins 2, 4, and 6 for +65 ±0.4 V. (See Figure 9.)

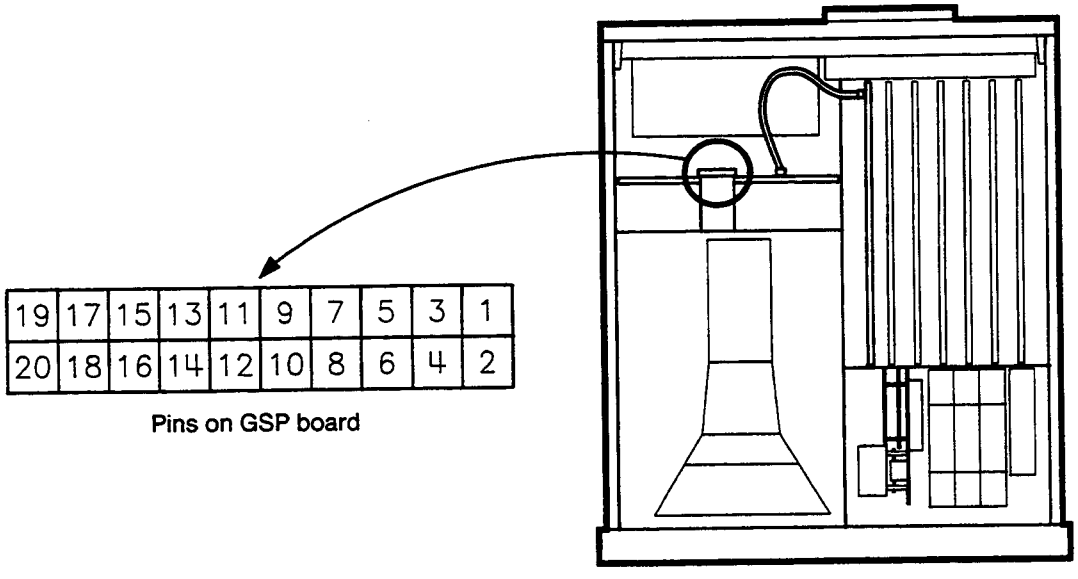


Figure 9. A18 Display Voltages

If the voltages are incorrect, continue with the next check. Otherwise, go to *Run Internal Display Tests*.

Measure Display Power Supply Voltages Entering A19

Measure the power supply voltages entering the A19 assembly coming from the A8 assembly. Check pins 1 and 2 for +65 ±0.4 V, and pin 6 for +5.16 ±0.1 V. See Figure 10.

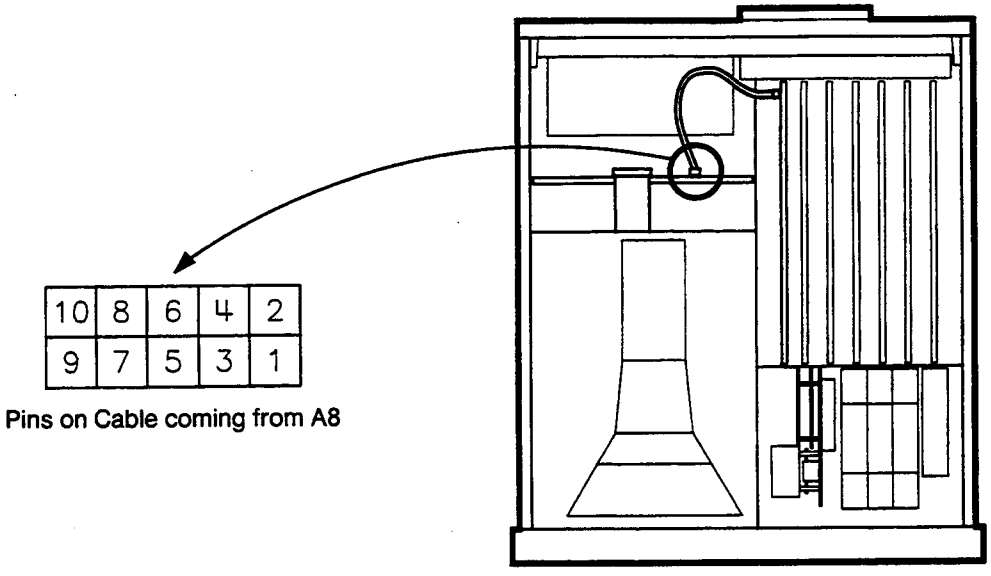


Figure 10. A19 GSP Voltages

If the voltages are incorrect, refer to the *Power Supply* section.

If the voltages are correct entering, but incorrect leaving the GSP assembly, replace the A19 GSP assembly.

Run Display Test 58

On the analyzer, press **[PRESET] [SYSTEM]** ***[SERVICE MENU]*** (softkey 8) **[TESTS]** (softkey 1) ***[DISPLAY TESTS]*** (softkey 7). The CRT will display: `58 Disp/cpu com -ND-`

Press ***[EXECUTE TEST]*** (softkey 8). The display will blank and the front panel LEDs will flash. All of the LEDs will go off and the display will remain blank if the test passes. If any of the front panel LEDs remain on, the test has failed.

If the test passes, go to *Run Display Tests 59-64*. Otherwise, continue with the next check.

Inspect Ribbon Cable and Repeat Display Test 58

Inspect the A9-A19 ribbon cable for a loose connection. Repeat *Run Display Test 58*. If the test fails, a walking one pattern will be continuously transferred from the CPU, through the cable, to the GSP. Immediately go to the next check.

Perform Walking One Pattern

Disconnect the A19 end of the A9-A19 ribbon cable. Use an oscilloscope to verify a walking one pattern is transfering from the A9 CPU through the cable. The walking one pattern is found on pins 3 through 10, and 13 through 20. See Figure 11.

34	32	30	28	26	24	22	20 → 2
33	31	29	27	25	23	21	19 → 1

Pin Locations on A19

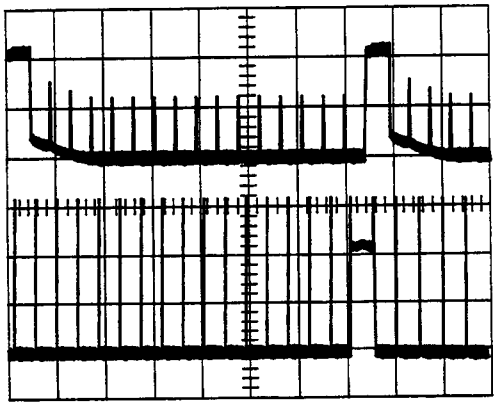


Figure 11. A9 CPU Walking One Pattern

If the signal is not present at the end of the cable, check for it at the A9 connector of the ribbon cable. If the signal is still not present, replace the A9 assembly.

Run Display Tests 59-64

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU]*** (softkey 8) ***[TESTS]*** (softkey 1) ***[DISPLAY TESTS]*** (softkey 7) **[59] [x1]**.

Press ***[EXECUTE TEST]*** (softkey 8). The display will blank and the front panel LEDs will flash. If the test passes, all the LEDs will go off and the display will remain blank.

Repeat these steps for display tests 60 through 64 (substitute the next test number where **[59]** was used). Watch for the LEDs to go off and the display to blank except for test 64. Test 64 causes the display to dim rather than blank.

If any of the display tests fail, replace the A19 assembly.

If all of the following is true, replace the A18 display assembly.

- CPU test passes the LED test.
- GSP passes all of the internal display tests (58 through 64).
- Power supply checks out.
- Intensity, focus, and vertical adjustmets fail to produce an acceptable image.

IF THE FAULT IS INTERMITTENT

Repeat Test Function

If the failure is intermittent, press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [REPEAT ON] [RETURN] [TESTS]*** to turn on the repeat function. Then select te test desired and press ***[EXECUTE TEST]***. Press any key to stop the function. The test repeat function is explained in detail under *Test Option Menu* in the *Service Key Menus*.

PART III. HP-IB FAILURES

If you have performed the checks in *Troubleshooting*, and you believe there is an HP-IB problem in the analyzer, perform the following test. It checks the internal communication path between the A9 CPU and A16 rear panel. It does not check the HP-IB paths external to the instrument.

Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[13]** **[x1]** ***[EXECUTE TEST]*** to perform test 13 (rear panel).

If the test fails, the problem is likely to be the A16 rear panel.

If test 13 passes, it indicates that the A9 CPU can communicate with the A16 rear panel to a 50% confidence. There is a good chance that the A16 rear panel is bad. This is because internal bus lines have been exercised between the A9 CPU and A16, and HP-IB signal paths are not checked external to the analyzer.

Source Group Troubleshooting

REPAIR SEQUENCE

Troubleshooting: identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

Perform these procedures only after reading *Isolate Faulty Group Troubleshooting.* The source group assemblies are: A4 sampler/mixer, A11 phase lock, A3 source, A12 reference, A13 fractional-N (analog), A14 fractional-N (digital) and A7 pulse generator.

Make sure all of the assemblies are firmly seated. Also make sure that input R has a signal of at least −35 dBm (about 0.01 Vp-p into 50 ohms) at all times to maintain phase lock.

This section is divided into two troubleshooting procedures for the following problems:

- Incorrect power levels: Perform the *Power* troubleshooting checks.
- Phase lock error: Perform the *Phase Lock Error* troubleshooting checks.

Table 1. Source Group Troubleshooting Summary (1 of 2)

This overview summarizes the sequence of checks included in this section. Experienced technicians need refer to little else. Others should begin troubleshooting with the first item in *Power* or *Phase Lock Error*, depending on the type of failure. The headings of the detailed procedures in this section are in bold print.

POWER

1. Run **Internal Adjustment Test 44 —Source Def**. If the power levels are approximately correct, continue with item 2.

   If these tests fail, replace the source.

2. Run the **RF Output Power Correction Constants**.

   If this procedure fails, or if the power levels are not correct, proceed with item 3.

3. Run the **Sampler Magnitude and Phase Correction Constants**.

   If this procedure fails, replace the source.

   If this procedure is successfully completed, repeat step 2. If step 2 now fails, replace the source.

PHASE LOCK ERROR

1. Troubleshoot any **Phase Lock Loop Error Message** first by running service test 48.

   Load the new pretune correction constants if an improvement is evident.

2. Perform the **A4 Sampler/Mixer Check** by using sampler A for phase lock. (Move the A7 pulse generator cable from A4 to A5.)

   Suspect the input cable and sampler if the symptoms disappear.

3. Perform the **A3 Source and A11 Phase Lock Check** by opening the phase-locked loop with the SRC TUNE service mode. Observe the RF output with an oscilloscope.

   Isolate the problem to the A11 phase lock or A3 source assembly by using **[SOURCE PLL OFF]** if the symptoms persist in open loop mode.

4. Perform the **A12 Reference Check** by monitoring the signals of Table 4.

   - If the PL REF signal is bad in low band and the FN LO signal is good at A14J2, the A12 assembly is faulty.
   - If the PL REF signal is bad in low band and the FN LO signal is bad at A14J2, refer to **A13/A14 Fractional-N Check**.

   If any other A12 signals are bad, either perform the **A12 Digital Control Signals Check** or consider the A12 assembly defective.

Table 1. Source Group Troubleshooting Summary (1 of 2)

5. Perform the **A13/A14 Fractional-N Check** with the fractional-N counter to determine the VCO frequency range.

   If the readings are good, the A13/A14 assemblies are 90% verified.

   - Perform the **A7 Pulse Generator Check** or
   - Use the FRAC-N TUNE service mode to see if A14J1 outputs a 10 to 60 MHz signal.

   If the readings are bad, refer to the **A14 VCO Range Check** and the **A14 Divide-by-N Circuit Check**.

6. Perform the **A7 Pulse Generator Check** with a spectrum analyzer. The pulse generator output should look like Figure 22 when the network (or lightwave) analyzer is set to 16 MHz CW.

   If the output is bad, the A7 assembly is defective.

   If the symptoms are frequency specific, observe the comb tooth more closely at the frequency of concern.

7. Perform the **A11 Phase Lock Check** by examining the signals listed in Table 9. Refer to the **Appendix** for additional help.

POWER

If the analyzer output power levels are incorrect but no phase lock error is present, perform the following checks in the order given:

1. **Internal Adjustment Test 44 — Source Def**

   To run this test, press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[44] [x1]** ***[EXECUTE TEST]***. When complete, "DONE" should appear on the CRT. Use a power meter or oscilloscope to verify that source power can be controlled and that the power level is approximately correct. If the source passes these checks, proceed with item 2. However, if "FAIL" appears on the CRT, or if the checks fail, replace the source.

2. **RF Output Power Correction Constants**

   Follow the instructions for this procedure given in the *Adjustments* section. The procedure is complete when "DONE" appears on the CRT. Use a power meter or oscilloscope to verify that power levels are now correct (as in item 1). If power levels are not correct, or if the RF Power Correction Constants routine fails, proceed with item 3.

3. **Sampler Magnitude and Phase Correction Constants**

   Follow the instructions for this procedure given in the *Adjustments* section. The procedure is complete when "DONE" appears on the CRT. Now repeat the *RF Output Power Correction Constants* routine, item 2. If item 2 now fails, replace the source.

   If the *Sampler Magnitude and Phase Correction Constants* routine failed, replace the source.

PHASE LOCK ERROR

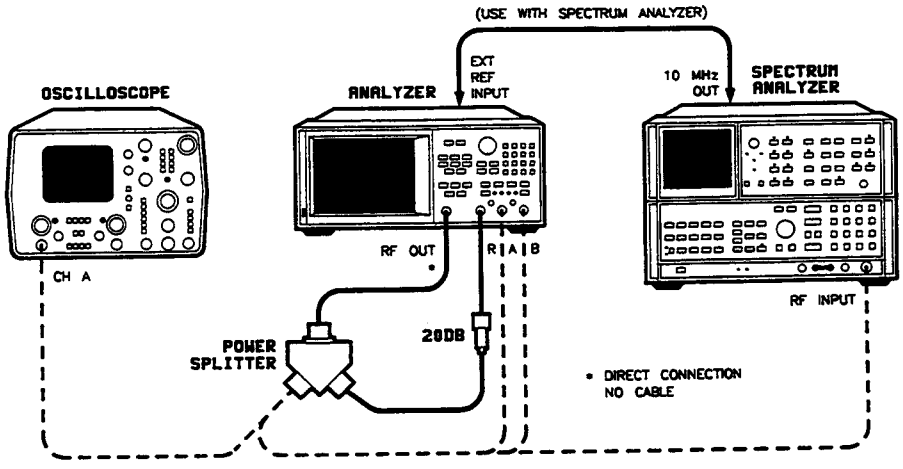


Figure 1. Basic Phase Lock Error Troubleshooting Equipment Setup

Troubleshooting tools include the assembly location diagram and phase lock diagnostic tools. The assembly location diagram is on the underside of the instrument top cover. The diagram shows major assembly locations and RF cable connections. The phase lock diagnostic tools are explained in the appendix and should be used to troubleshoot phase lock problems. The equipment setup shown in Figure 1 can be used throughout this section.

PHASE LOCK LOOP ERROR MESSAGE CHECK

Phase lock error messages may appear as a result of incorrect pretune correction constants. To check this possibility, perform the pretune correction constants routine.

The four phase lock error messages, listed below, are described in the *Source Group Troubleshooting Appendix* at the end of this section.

- NO IF FOUND: CHECK R INPUT LEVEL
- NO PHASE LOCK: CHECK R INPUT LEVEL
- PHASE LOCK CAL FAILED
- PHASE LOCK LOST

1. Connect the power splitter, RF cable and attenuator to inputs A and R as shown in Figure 1.

Make sure the A9 CC Jumper is in the ALTER position, as shown on the *Adjustments* tab.

2. Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[4] [6] [x1]** ***[EXECUTE TEST]*** to generate new analog bus correction constants. Then press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[4] [5] [x1]** ***[EXECUTE TEST]*** to generate default pretune correction constants.

If the analyzer still displays an error message, press **[MENU]** ***[POWER]*** **[2] [0] [x1]** to increase the output power. Rerun test 45.

Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[4] [8] [x1]** ***[EXECUTE TEST]*** ***[YES]*** to generate new pretune correction constants.

3. Press **[PRESET]** and observe the CRT:

- No error message: restore the A9 CC jumper to the NORMAL position. Then refer to *Post-Repair Procedures* to verify operation.
- Error message visible on HP 8753B/C or 8702A/B: continue with the *A4 Sampler/Mixer Check*.
- Error message visible on **HP 8753A ONLY**: check the firmware revision number (cycle power) and note the assembly numbers of the A9 CPU and A11 phase lock assemblies. Refer to Table 2 to see whether they are compatible.

  If the assemblies are not listed as compatible, refer to *HP 8753A Phase Lock Assembly Compatibility* in the *Source Group Troubleshooting Appendix* at the end of this section.

Table 2. HP 8753A Component Compatibility Matrix

Firmware Revision with	A9 CPU Assembly and	A11 Phaselock Assembly
1.00	08753-60009 or 08753-69009	08753-60060 or 08753-69060
1.01	08753-60009 or 08753-69009	08753-60082 or 08753-69082
1.01	08753-60079 or 08753-69079	08753-60082 08753-69082

A4 SAMPLER/MIXER CHECK

The A4, A5, and A6 (R, A and B) sampler/mixers are identical. Any sampler can be used to phase lock the source. To eliminate the possibility of a bad R sampler, follow this procedure.

1. Connect the power splitter, RF cable and attenuator to inputs A and R as shown in Figure 1.
2. Remove the top cover of the analyzer and turn it on.
3. Move the A11-to-A4 SMB cable from A4 to the corresponding A5 connector as shown in Figure 2 and in the location diagram under the top cover.

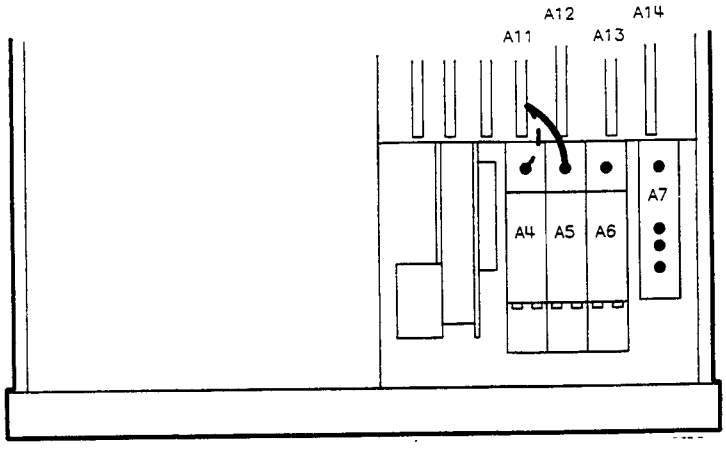


Figure 2. Sampler/Mixer to Phase Lock Cable Connection Diagram

4. Set the analyzer to measure input A. If the instrument makes valid measurements while phase locking on input A, the A4 (input R) sampler/mixer assembly is defective.
5. Reconnect the internal and external cables as found.

A3 SOURCE AND A11 PHASE LOCK CHECK

This procedure checks the source and part of the phase lock assembly. It opens the phase-locked loop and exercises the source by varying the source output frequency with the A11 pretune DAC. If internal test 48 failed, default pretune correction constants were stored which may result in a constant offset of several MHz. Regardless, continue with this procedure.

NOTE: Use a spectrum analyzer for problems above 100 MHz.

1. Connect the oscilloscope or spectrum analyzer as shown in Figure 1. (Set the oscilloscope input impedance to 50 ohms.)
2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SRC TUNE ON]*** to activate the source tune (SRC TUNE) service mode.
3. Use the RPG knob to adjust the pretune frequency to 300 kHz, 30 MHz and 40 MHz. Verify the signal frequency on the oscilloscope.

NOTE: In SRC TUNE mode, the source output frequency changes in 1 to 2 MHz increments and should be 1 to 6 MHz above the indicated output frequency.

4. Check for the frequencies indicated by Table 3.

Table 3. Output Frequency in SRC Tune Mode

Setting	Observed Frequency
300 kHz	1.3 to 6.3 MHz
30 MHz	31 to 36 MHz
40 MHz	41 to 46 MHz

5. The signal observed on an oscilloscope should be as solid as the signal in Figure 3.

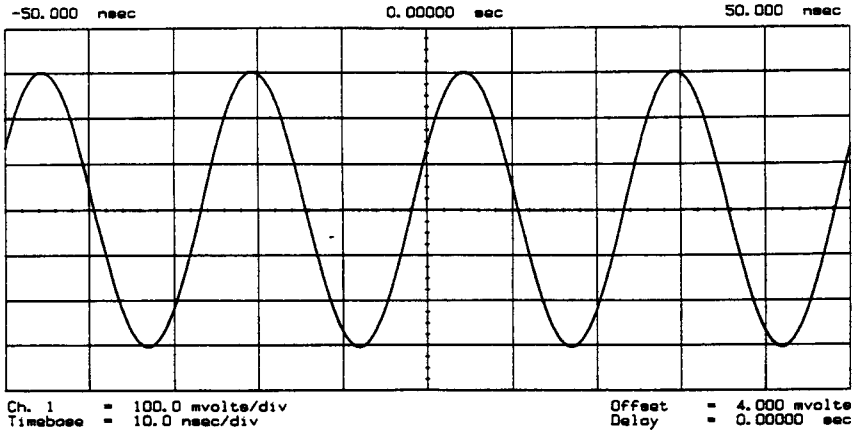
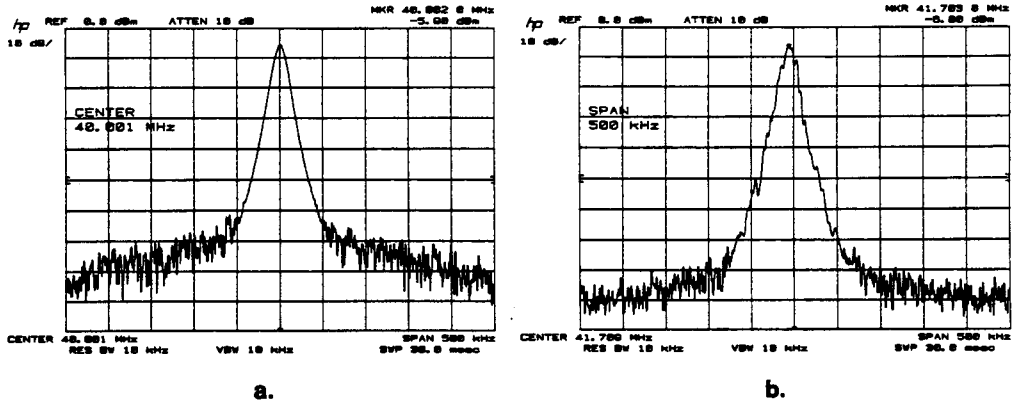


Figure 3. Waveform Integrity in SRC Tune Mode

6. The signal observed on the spectrum analyzer will appear jittery as in Figure 4 (b), not solid as in Figure 4 (a). This is because in SRC TUNE mode the output is not phase locked.



a. b.

Figure 4. Phase Locked Output Compared to Open Loop Output in SRC TUNE Mode

7. Press **[MENU]** ***[POWER]*** to vary the power and check for corresponding level changes on the test instrument. (A power change of 20 dB will change the voltage observed on the oscilloscope by a factor of ten.)

8. Note the results of the frequency and power changes:

- If the frequency and power output changes are proper, perform the *A12 Reference Check,* following.
- If the frequency changes are not correct, continue with one of the *YO Coil Drive Checks,* next.
- If the power output changes are not proper, check the voltage between ID+(TP2) and ID−(TP3) on the A3 source assembly (see Figure 5):
  - Voltage between 265 mV and 380 mV (or between 380mV and 485mV if so labeled): continue with the next check.
  - Voltage not as stated above: replace the A3 source assembly.

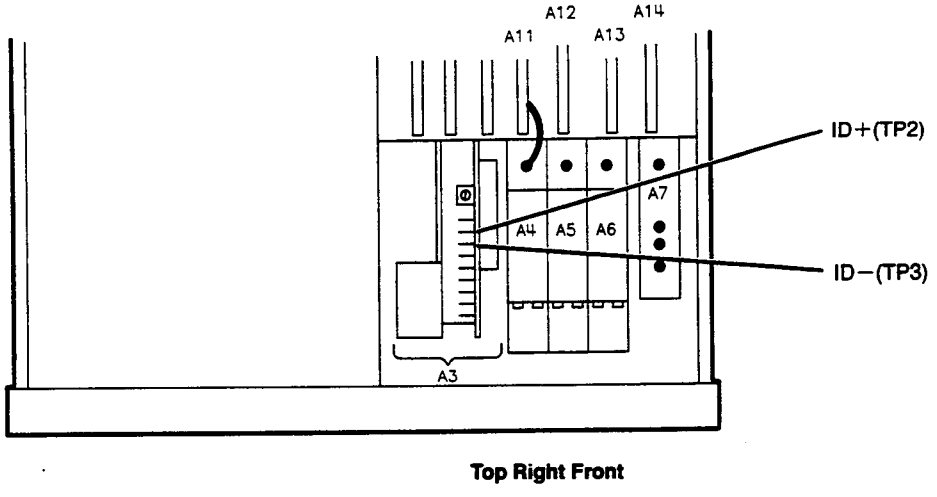


Figure 5. Location of ID+ and ID− on A3 Source Assembly]

YO Coil Drive Check with Analog Bus

NOTE: If the analog bus is not functional, perform the "YO Coil Drive Check with Oscilloscope" test.

1. Press **[PRESET]** **[SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** ***[SERVICE MODES]*** ***[SOURCE PLL OFF]*** **[MEAS]** ***[S PARAMETERS]*** ***[ANALOG IN]***. Then press **[1]** **[6]** **[x1]** **[FORMAT]** ***[MORE]*** ***[REAL]*** **[SCALE REF]** ***[AUTOSCALE]***. This keystroke sequence lets you check the pretune DAC and the A11 output to the YO coil drive by monitoring the 1V/GHz signal at analog bus node 16.
2. Compare the waveform to Figure 6. If the waveform is incorrect, the A11 phase lock assembly is faulty.

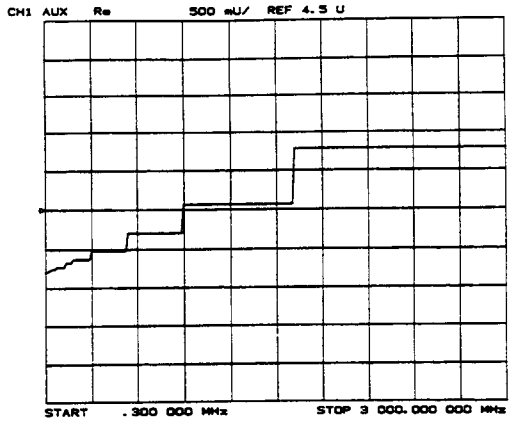


Figure 6. 1V/GHz at Analog Bus Node 16 with Source PLL Off.

YO Coil Drive Check with Oscilloscope

NOTE: Use the large extender board (part of the tool kit listed in Table 1 of *Service and Equipment Overview*) for easy access to the voltage points.

1. Connect oscilloscope probes to A11P1-1 and A11P1-2. The YO coil drive signal is actually two signals whose voltage difference drives the coil.
2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SOURCE PLL OFF]*** to operate the analyzer in a swept open loop mode.
3. Monitor the two YO coil drive lines. In source tune mode the voltage difference should vary from approximately 3.5 to 5.0 volts as shown in Figure 7.

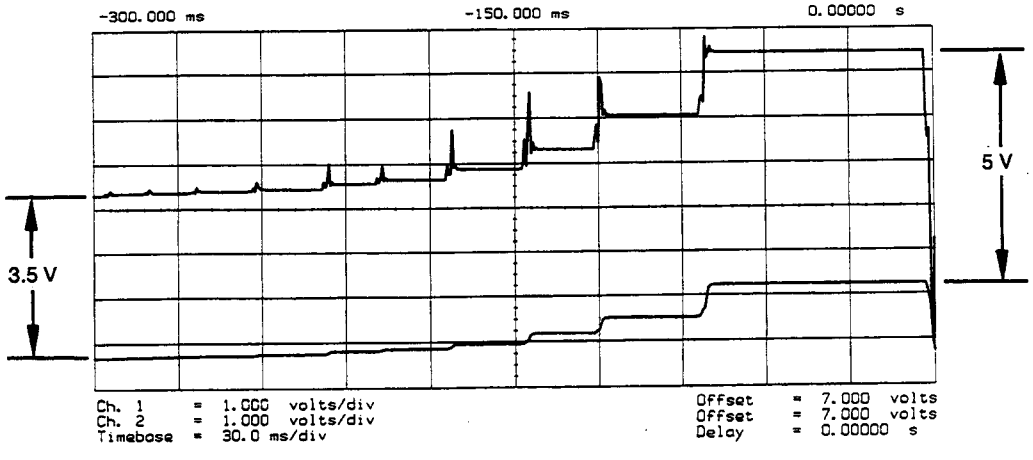


Figure 7. YO− and YO+ Coil Drive Voltage Differences with SOURCE PLL OFF

4. If the voltages are not correct, the A11 assembly is faulty.
5. If the output signals from the A11 assembly are correct, the A3 source assembly is faulty and must be replaced.
6. If neither the A11, nor the A3 assembly is faulty, continue with the next check.

A12 REFERENCE CHECK

The signals are evaluated with pass/fail checks. You can quickly check them with the analog bus and Table 3 or use an oscilloscope and Figures 8 through 14.

If any of the observed signals differs from the figures, there is a 90% probability that the A12 assembly is faulty. Either consider the A12 assembly defective or perform the *A12 Digital Control Signals Check.*

A12 Frequency Reference Signals Check

The most efficient way to check the A12 frequency reference signals is to use the analog bus. Alternatively an oscilloscope may be used. Both of these procedures follow; use either one.

Analog Bus Method. You need not use the oscilloscope method unless the analog bus is non-functional or any of the signals fail the specifications listed in Table 3.

1. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MEAS]** ***[S-PARAMETERS] [ANALOG IN] [ANALOG BUS]*** to turn on the analog bus and its counter.
2. Press **[2] [1] [x1]** to count the frequency of the 100 kHz signal.
3. Press **[MENU]** ***[CW FREQ]*** and enter in turn the three frequencies listed in Table 4.

Table 4. Analog Bus Check of Reference Frequencies

CW Frequency	100 kHz (21*)	2nd LO (24*)	PLREF (25*)
500 kHz CW	0.100 MHz	0.504 MHz	0.500 MHz
2 MHz CW	0.100 MHz	2.004 MHz	2.000 MHz
50 MHz CW	0.100 MHz	0.996 MHz	1.000 MHz

* analog bus node

The counter should indicate the frequencies listed plus or minus 0.1%. Accuracy may vary with gate time and signal strength.

4. In similar fashion, press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN] [ANALOG BUS]*** **[2] [4] [x1]** and then **[2] [5] [x1]** to check the frequencies of the 2nd LO and the PLREF signals.

   a. If the frequencies are within the limits shown, continue with the *A13/A14 Fractional-N Check.*

   b. If the signals are incorrect at the 500 kHz and 2 MHz settings only, go to the *FN LO at A12 Check.*

   c. If all three signals are incorrect at all three frequencies, the counter may be faulty. Perform the *Oscilloscope Method* check of the signals. (If the signals are good, suspect the A10 and A14 assemblies.)

Oscilloscope Method. If the analog bus is non-functional or the previous check has revealed suspect signals, observe the signal(s) with an oscilloscope. Table 5 identifies a convenient test point and a plot for the five signals listed.

Table 5. A12 Reference Frequencies

Mnemonic	Signal Description	Location	See Figure	Analyzer Setting
FN100kHzREF	100 kHz Reference	A13TP5	8	any
REF	Phase Lock Reference	A11TP9	9	>16 MHz CW
REF	Phase Lock Reference	A11TP9	10	5 MHz CW
FN LO*	Fractional-N LO	A14J2	11	10 MHz CW
4MHz REF	4 MHz Reference	A12TP9	12	any
2ND LO+/−	Second LO	A12P1-2,4	13	>16 MHz CW
2ND LO+/−	Second LO	A12P1-2,4	14	14 MHz CW
*not an A12 signal, but required for A12 lowband operation				

100 kHz Pulses

The 100 kHz pulses are very narrow and typically 1.5V in amplitude. You may have to increase the oscilloscope intensity to see these pulses.

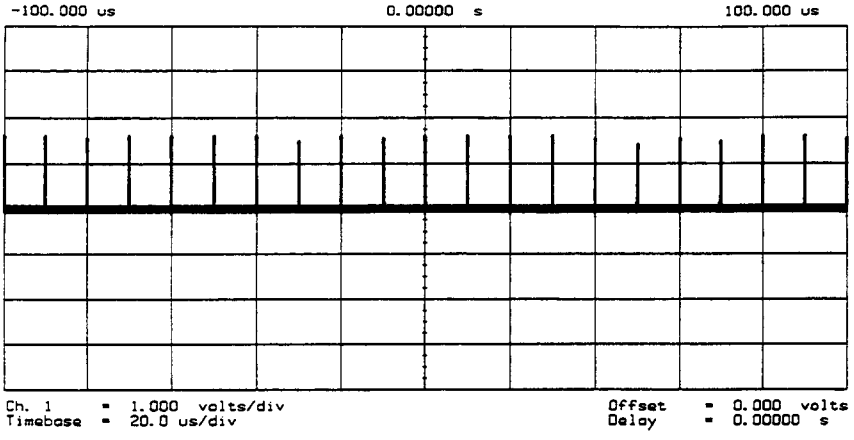


Figure 8. Sharp 100 kHz Pulses at A13TP5 (any frequency)

PLREF Waveforms

REF Signal at A11TP9. REF is the buffered PLREF+ signal. The 1st IF is phase locked to this signal. Use an oscilloscope to observe the signal at the frequencies noted in Figures 9 and 10.

High Band REF Signal. In high band the REF signal is a constant 1 MHz square wave as indicated by Figure 9.

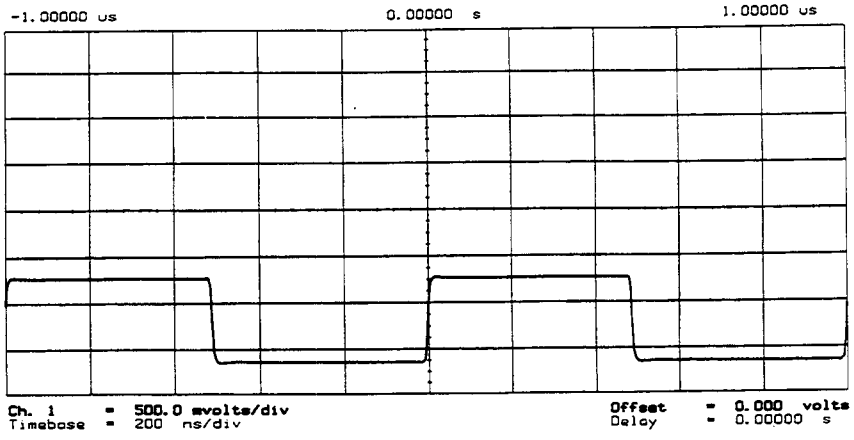


Figure 9. High Band REF Signal (>16 MHz CW)

Low Band REF Signal. In low band this signal follows the frequency of the RF output signal. Figure 10 illustrates a 5 MHz CW signal.

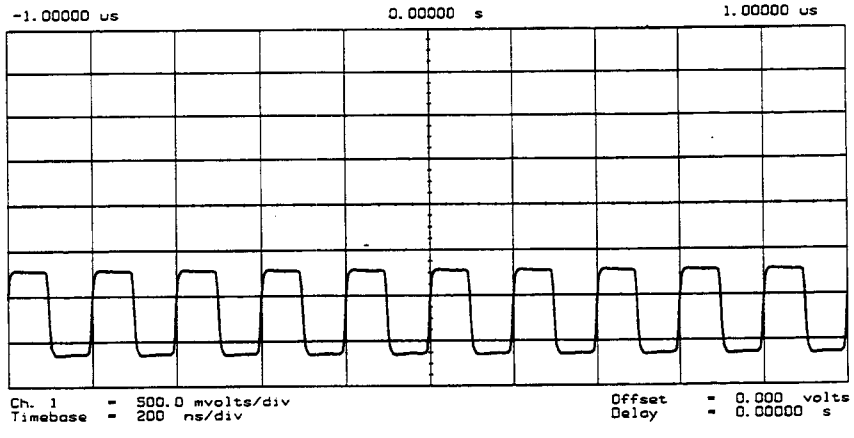


Figure 10. REF Signal at A11TP9 (5 MHz CW)

If REF looks good, continue with the *4 MHz Reference Signal* check.

If REF is bad in low band, perform the *FN LO at A12 Check*.

FN LO at A12 Check

1. Use an oscilloscope to observe the FN LO from A14 at the cable end of A14J2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [FRACN TUNE ON]*** to turn on the fractional-N service mode.

2. Use the RPG to vary the frequency from 30 to 60 MHz. The signal should appear similar to Figure 11. The display will indicate 10 to 60.8 MHz.

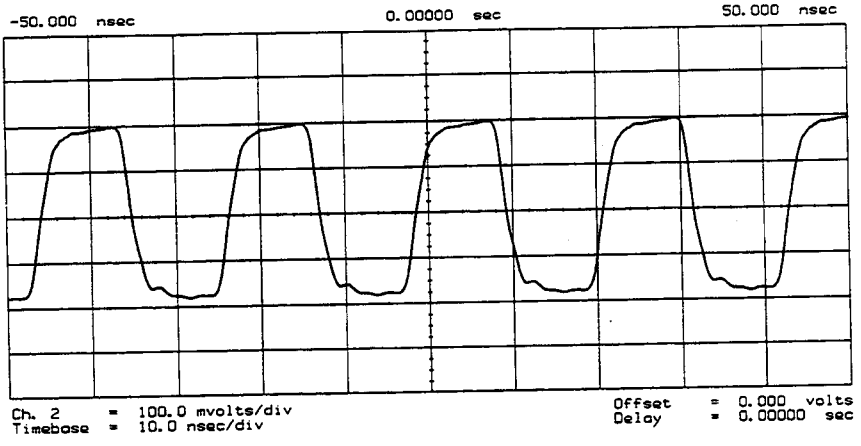


Figure 11. Typical FN LO Waveform at A12J1

3. If the FN LO signal is good, the A12 assembly is bad.

   If the FN LO signal is not good, continue with the *A13/A14 Fractional-N Check.*

4 MHz Reference Signal

This reference signal is used to control the receiver. If faulty, this signal can cause apparent source problems because the CPU uses receiver data to control the source. At A12TP9 it should appear similar to Figure 12.

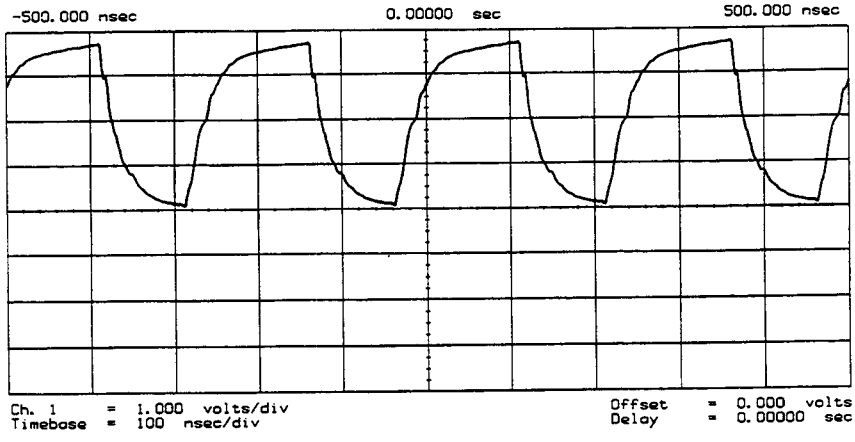


Figure 12. 4 MHz Reference Signal at A12TP9 (Preset)

2ND LO Waveforms

The 2nd LO signals appear different in phase and shape at different frequencies.

90 Degree Phase Offset of 2nd LO Signals in High Band. In high band, the 2nd LO is 996 kHz. As indicated by Figure 13, the 2nd LO actually consists of two signals 90 degrees out of phase.

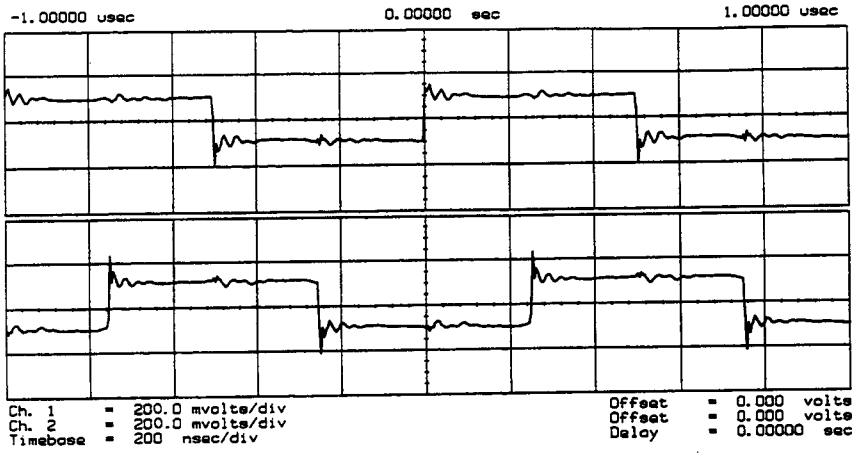


Figure 13. 90 Degree Phase Offset of High Band 2nd LO Signals (>16 MHz CW)

In-Phase 2nd LO Signals in Low Band. The 2nd LO signals in low band, as shown in Figure 14, are not phase shifted. In low band these signals track the RF output with a 4 kHz offset.

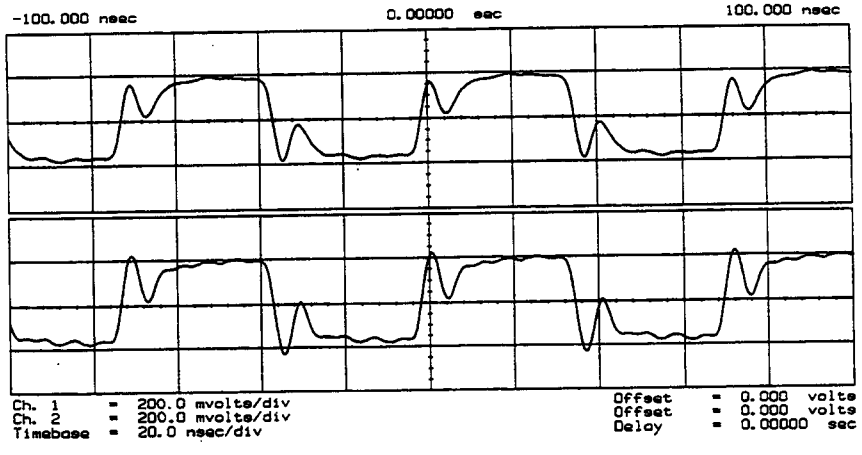


Figure 14. In-Phase Low Band 2nd LO Signals (14 MHz CW)

If any of the signals of Table 4 is incorrect, the probability is 90% that the A12 assembly is faulty. Either consider the A12 assembly faulty or perform the *A12 Digital Control Signals Check*, next.

A12 Digital Control Signals Check

Several digital control signals must be functional for the A12 assembly to operate properly. Check the control lines listed in Table 6 with the oscilloscope in the high input impedance setting. The source of each of these signals is indicated in the wiring list.

Table 6. A12-Related Digital Control Signals

Mnemonic	Signal Description	Location	See Figure	Analyzer Setting
L ENREF	L=Reference Enable	A12P2-6	15	Preset
L HB	L=High Band	A12P2-32	16	Preset
L LB	L=Low Band	A12P1-23	16	Preset

L ENREF Line. This is a TTL signal. To observe it, trigger on the negative edge. In preset state, the signal should show activity similar to Figure 15.

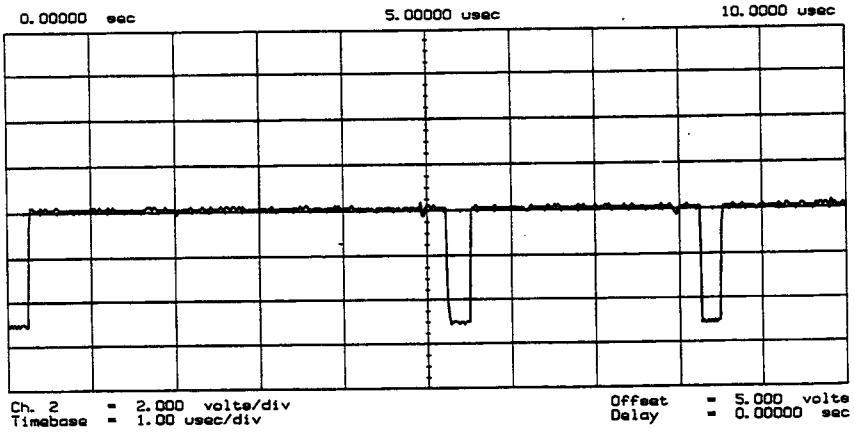


Figure 15. L ENREF Line at A12P2-16 (Preset)

L HB and L LB Lines: These complementary signals toggle when the instrument switches from low band to high band as illustrated by Figure 16.

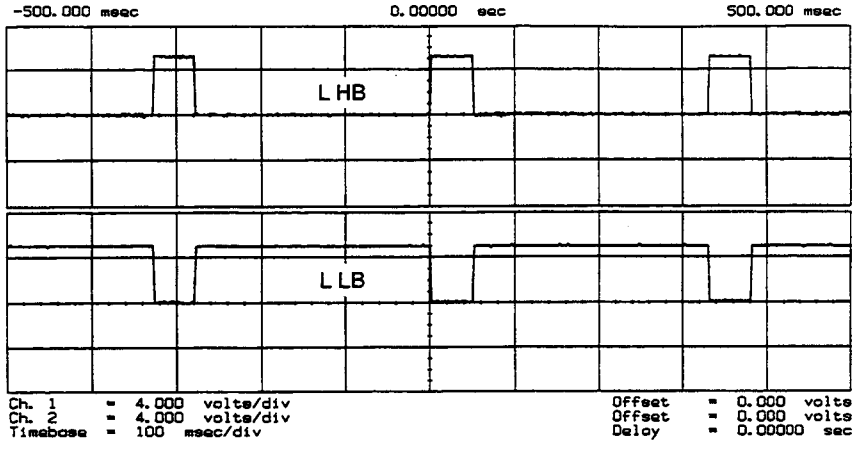


Figure 16. Complementary L HB and L LB Signals (Preset)

If all of the digital signals appeared good, the A12 assembly is bad.

A13/A14 FRACTIONAL-N CHECK

Use the analog bus or an oscilloscope to check the A14 VCO's ability to sweep from 30 MHz to 60 MHz. The faster analog bus method should suffice unless problems are detected.

Fractional-N Check with Analog Bus

1. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MEAS]** ***[S-PARAMETERS] [ANALOG IN] [FRAC N]*** to turn on the analog bus and the fractional-N counter. Then press **[MENU]** ***[CW FREQ]*** to set the analyzer to CW mode.
2. Set the instrument as indicated in Table 7 and see whether the VCO generates the frequencies listed.

Table 7. VCO Range Check Frequencies

Instrument Setting	Counter Reading
31 MHz	30 ± 0.030 MHz
60.999999 MHz	60 ± 0.060 MHz

3. Check the counter reading at the frequencies indicated.

   a. If the readings are within the limits specified, the probability is greater than 90% that the fractional-N assemblies are functional. Either continue with the *A7 Pulse Generator Check* or perform the more conclusive *A14 VCO Range Check with Oscilloscope.*

   b. If the readings fail the specified limits, perform the *A14 VCO Exercise.*

A14 VCO Range Check with Oscilloscope

1. Remove the HI OUT cable (A14J1 to A7) from the A7 assembly and connect it to an oscilloscope set for 50 ohm input impedance. Turn on the analyzer.

2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [FRACN TUNE ON]*** to activate the FRACN TUNE service mode. See the *Service Key Menus* section for more information on the FRACN TUNE mode.

3. Vary the fractional-N VCO frequency with the RPG knob and check the signal with the oscilloscope. The waveform should resemble Figures 17, 18 and 19.

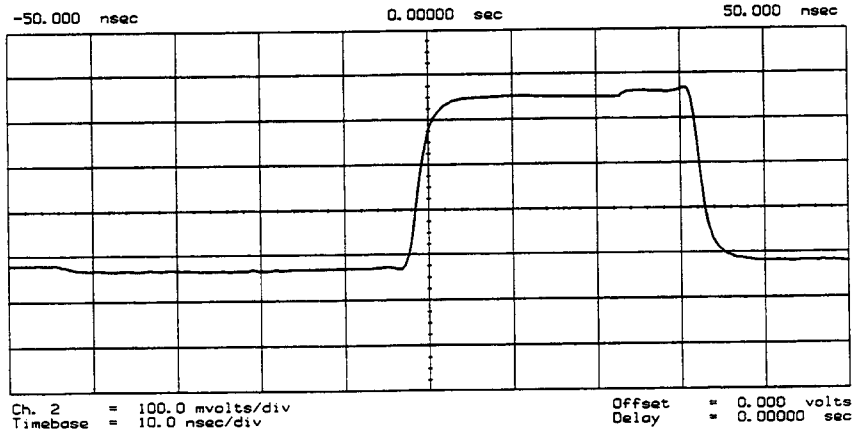


Figure 17. 10 MHz HI OUT Waveform from A14J1

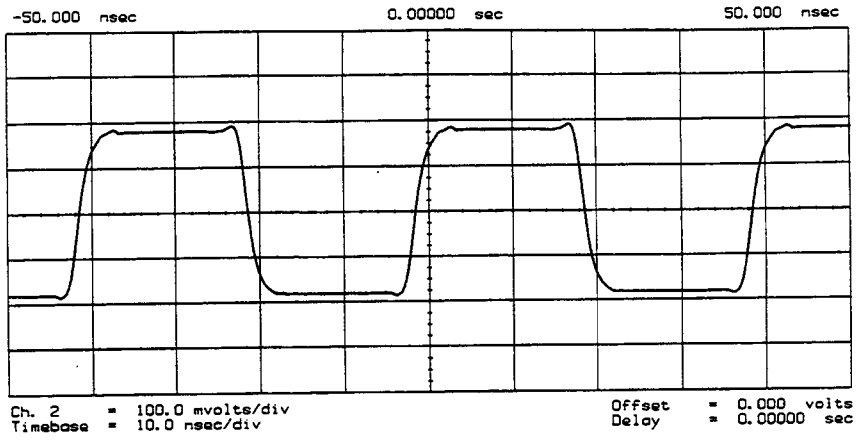


Figure 18. 25 MHz HI OUT Waveform from A14J1

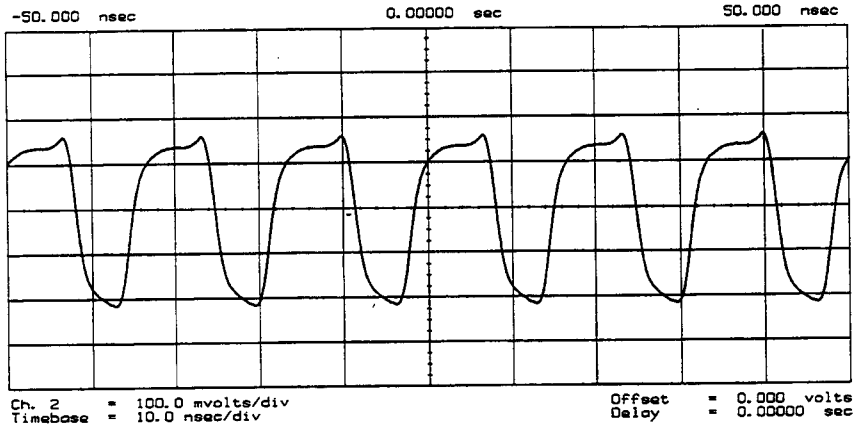


Figure 19. 60 MHz HI OUT Waveform from A14J1

4. If the fractional-N output signals are correct, continue source troubleshooting with the *A7 Pulse Generator Check* procedure.

A14 VCO Exercise

The nominal tuning voltage range of the VCO is +10 to −5 volts. When the analyzer is in operation, this voltage is supplied by the A13 assembly. This procedure substitutes a power supply for the A13 assembly to check the frequency range of the A14 VCO.

1. Turn off the analyzer and remove the A13 assembly.
2. Put the A14 assembly on an extender board and turn on the instrument.
3. Prepare to monitor the VCO frequency, either by:
   - Activating the analog bus and setting the internal counter to the FRACN node, or
   - Connecting an oscilloscope to A14J2 (labeled LO OUT) and looking for waveforms similar to Figure 11 (previously shown in *FN LO at A12 Check*.
4. Vary the voltage at A14TP14 from +10 to −5 volts either by:
   - Connecting an appropriate external power supply to A14TP14, or
   - First jumpering the +15V internal power supply at A8TP8 to A14TP14 and then jumpering the −5.2V supply at A8TP10 to A14TP14.
5. Confirm that the VCO frequency changes from approximately 30 MHz or less to 60 MHz or more.
6. If this procedure produces unexpected results, the A14 assembly is bad.
7. If this procedure produces the expected results, continue with the *A14 Divide-by-N Circuit Check*.

A14 Divide-by-N Circuit Check

NOTE: The A13 assembly should still be out of the instrument and the A14 assembly on an extender board.

1. Ground A14TP14 and confirm (as in the *A14 VCO Exercise*) that the VCO oscillates at approximately 50 to 55 MHz.)
2. Put the analyzer in CW mode (to avoid relock transitions) and activate the FRACN TUNE service mode.
3. Connect an oscilloscope to A14J3 and observe the output.
4. With the FRACN TUNE service feature, vary the frequency from 30 MHz to 60.8 MHz.
5. The period of the observed signal should vary from 5.5 µs to 11 µs.
6. If this procedure produces unexpected results, the A14 assembly is faulty.
7. If this procedure produces the expected results, perform the *A14-to-A13 Digital Control Signals Check*.

A14-to-A13 Digital Control Signals Check

The A14 assembly generates a TTL cycle start (CST) signal every 10 microseconds. If the VCO is oscillating and the CST signal is not detectable at A14TP3, the A14 assembly is non-functional.

Use the CST signal as an external trigger for the oscilloscope and monitor the signals in Table 8. Since these TTL signals are generated by A14 to control A13, check them at A13 first. Place A13 on the large extender board. The signals should look similar to Figure 20.

Table 8. A14-to-A13 Digital Control Signal Locations

Mnemonic	A13 Location	A14 Location
CST	none	TP3
L FNHOLD	P2-2	P2-2
FNBIAS	P2-5	P2-5
API1	P2-32	P2-32
API2	P2-3	P2-3
API3	P2-34	P2-34
API4	P2-4	P2-4
API5	P2-35	P2-35
FNLATCH	P1-28	P1-58

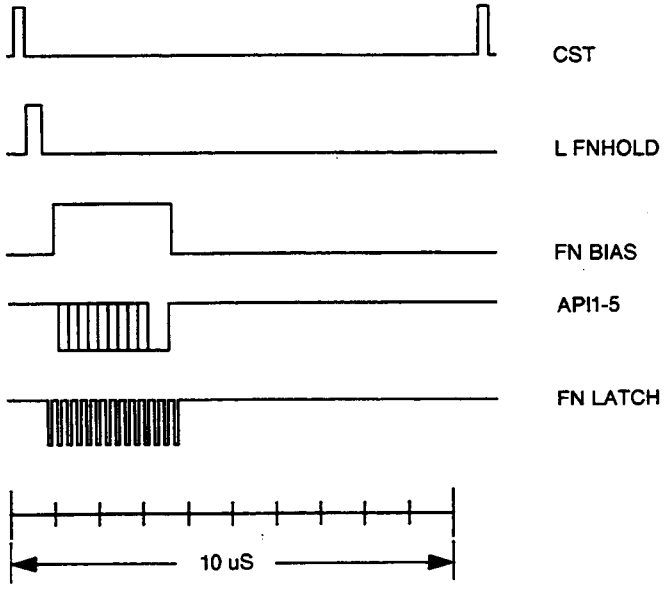


Figure 20. A14 Generated Digital Control Signals

If these signals are good, the A13 assembly is defective.

H MB Line. This signal is active during the 16 MHz to 31 MHz sweep. The upper trace of Figure 21 shows relative inactivity of this signal during preset condition. The lower trace shows its status during a 16 MHz to 31 MHz sweep with inactivity during retrace only.

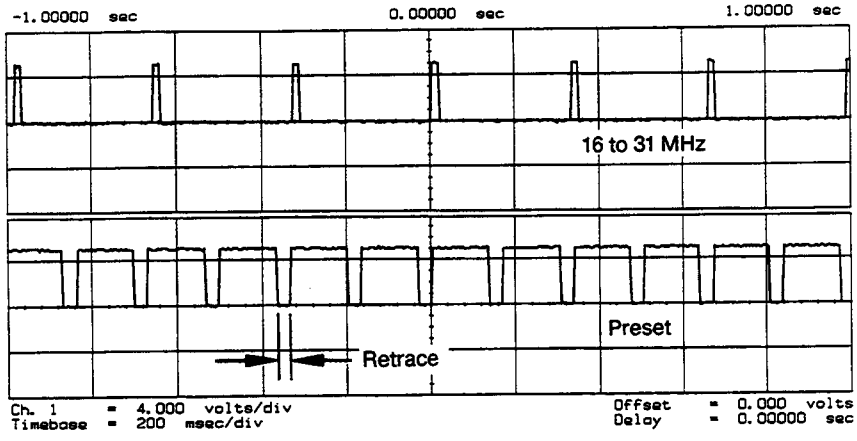


Figure 21. H MB Signal at A14P1-5 (Preset and 16 MHz to 31 MHz Sweep)

A7 PULSE GENERATOR CHECK

The pulse generator affects phase lock in high band only. It can be checked with either a spectrum analyzer or an oscilloscope.

A7 Pulse Generator Check with Spectrum Analyzer

1. Remove the A7-to-A6 SMB cable (W7) from the A7 pulse generator assembly. Set the analyzer to generate a 16 MHz CW signal. Connect the spectrum analyzer to the A7 output connector and observe the signal. The A7 comb should resemble the spectral display in Figure 22.

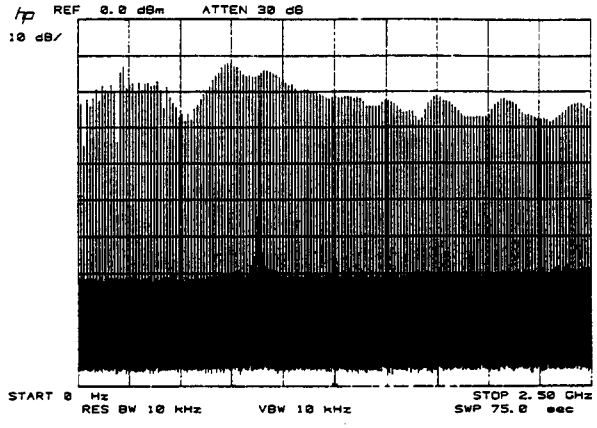


Figure 22. Pulse Generator Output

2. If the analyzer malfuction relates to a particular frequency or range, look more closely at the comb tooth there. Adjust the spectrum analyzer span and bandwidth as required. Even at 3 GHz, the comb should look as clean as Figure 23.

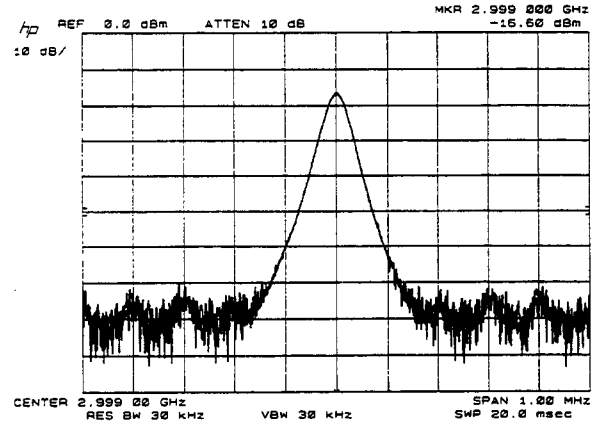


Figure 23. High Quality Comb Tooth at 3 GHz

3. If the signal at the A7 output is good, check the A7-to-A4 cable.

4. If the signal is not as clean as Figure 23, observe the HI OUT input signal to the A7 assembly.

   a. On the network (or component) analyzer, set **[PLL AUTO OFF]**. Otherwise do not readjust the instrument. Remove the A14-to-A7 SMB cable (W9) from the A7 pulse generator assembly.

   b. Set the spectrum analyzer to a center frequency of 45 MHz and a span of 30 MHz. Connect it to the A14-to-A7 cable still attached to the A14 assembly. Narrow the span and bandwidth to observe the signal closely.

5. If the HI OUT signal is as clean as Figure 24, the A7 assembly is bad.

   Otherwise check the A14-to-A7 cable or reinspect the A13/A14 fractional-N as noted below.

NOTE: Some phase lock problems may result from phase noise problems in the fractional-N loop. To troubleshoot this unusual failure mode, set the network (or lightwave) analyzer at 60 MHz in the FRACN TUNE mode. On a spectrum analyzer, the HI OUT signal from the A14 assembly should appear as clean as Figure 24. The comb shape may vary from pulse generator to pulse generator.

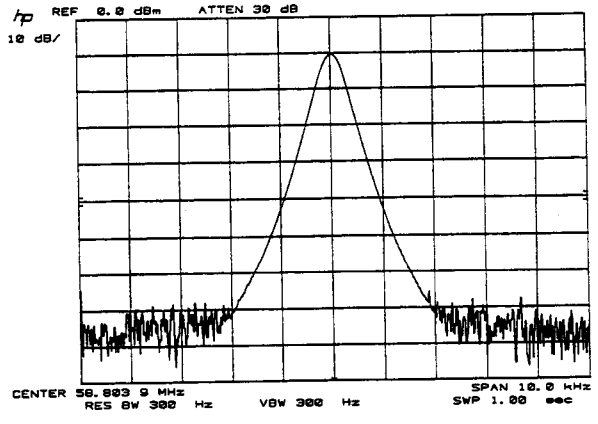


Figure 24. Stable HI OUT Signal in FRACN TUNE Mode

A7 Pulse Generator Check with Oscilloscope

Perform this check if a spectrum analyzer is not available.

1. Remove the A4-to-A11 SMB cable from the A4 (R) sampler/mixer output. Connect the oscilloscope to the A4 output (1st IF).
2. Activate the FRACN TUNE service mode and tune the fractional-N to 50 MHz.
3. Activate the SRC TUNE service mode of the analyzer and tune the source to 50 MHz.

4. Set the SRC TUNE frequency to those listed in Table 9 and observe the 1st IF waveforms. They should appear similar to Figure 25.

Table 9. 1st IF Waveform Settings

SRC TUNE	FRACN	Harmonic	1st IF
50 MHz	50 MHz	1	1 to 6 MHz
250 MHz	50 MHz	5	1 to 6 MHz
2550 MHz	50 MHz	51	1 to 6 MHz

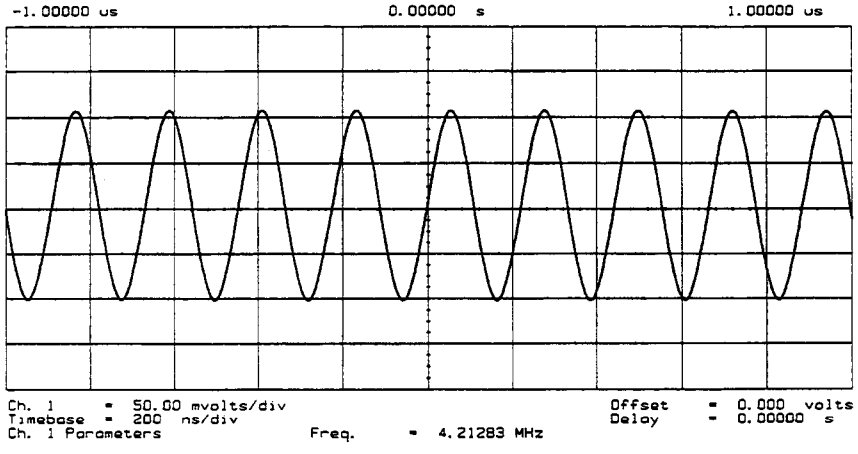


Figure 25. Typical 1st IF Waveform in FRACN TUNE/SRC TUNE Mode

5. If the signals observed are proper, continue with "A11 Phase Lock Check."

6. If the signals observed are suspect, get a spectrum analyzer and perform the preceding *A7 Pulse Generator Check with Spectrum Analyzer* procedure.

A11 PHASE LOCK CHECK

At this point, the A11 phase lock assembly appears to be faulty (its inputs should have been verified already). Nevertheless, you may elect to use the phase lock diagnostic routines or check the relevant signals at the assembly itself for confirmation.

NOTE: If external source mode is the only operating mode with phase lock problems, replace the A11 phase lock assembly.

Phase Lock Check with PLL DIAG

Refer to *Phase Lock Diagnostic Tools* in the appendix of this section for an explanation of the error messages and the diagnostic routines. Follow the steps there to determine in which state the phase lock is lost.

If "NO IF FOUND" is displayed, confirm that the analog bus is functional and perform the *Source Pretune Correction Constants* as outlined in the *Adjustments* section.

If phase lock is lost in the ACQUIRE state, the A11 assembly is faulty.

If phase lock is lost in the TRACK state, suspect source phase lock loop components other than the A11 assembly.

Phase Lock Check by Signal Examination

To confirm that the A11 assembly is receiving the signals required for its proper operation, perform the following steps.

1. Place the A11 assembly on the large extender board.
2. Turn on the analyzer and press **[PRESET]**.
3. Check for the signals listed in Table 10.

Table 10. A11 Input Signals

Mnemonic	I/O	Access	See Figure	Notes
FM COIL −	O	A11P1-3,33	26	Aids YO COIL in setting YIG. Press **[PRESET] [MENU]** ***[NUMBER OF POINTS]*** **[3] [x1]** to observe this signal.
REF	I	A11TP9	9, 10	Observe both low band and high band CW frequencies.
YO COIL +	O	A11P1-2,32	7	Use ***[SOURCE PLL OFF]***.
YO COIL −	O	A11P1-1,31	7	
1ST IF	I	A11 PL IF IN	25	Check for 1 MHz with tee at A11 jack (not at cable end) in high band.

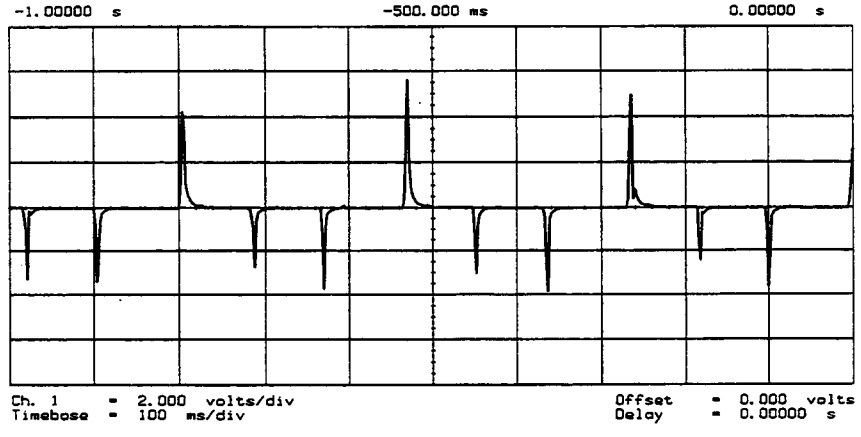


Figure 26. FM COIL − Plot with 3 Point Sweep

4. If any of the input signals is not proper, refer to the wiring list (in the *Troubleshooting* section) as an aid to troubleshooting the problem to its source.

5. If any of the output signals is not proper, the A11 assembly is bad.

TROUBLESHOOTING SOURCE PROBLEMS WITH THE ANALOG BUS

The analog bus can perform a variety of fast checks. However it too is subject to failure and thus should be tested prior to use. This should have been performed in *Isolate Faulty Group.*

To use the analog bus (after test) to check any one of the nodes, press **[MENU]** ***[TRIGGER MENU]*** ***[CONTINUOUS]*** to restart the sweep. (The instrument must sweep to update the analog bus.) Then press **[MEAS]** ***[ANALOG IN]*** and enter the analog bus node number followed by **[x1]**. Refer to *Analog Bus* in the *Service Key Menus* part of this manual for additional information.

PHASE LOCK DIAGNOSTIC TOOLS

The analyzer incorporates diagnostic tools to help troubleshoot phase-lock problems. These problems can be especially taxing when intermittent or associated with fast or narrow sweeps. The diagnostic tools are four error messages and three diagnostic features.

Phase Lock Error Messages

Four different phase lock error messages are generated at four different stages of the sweep and thus can help define the problem. Three of these messages suggest source problems. One message can result from either source or receiver problems.

All phase lock error messages can result from improper front panel connections.

NO IF FOUND: CHECK R INPUT LEVEL means no IF was detected during pretune: a source problem. Perform the "A4 Sampler/Mixer Check."

NO PHASE LOCK: CHECK R INPUT LEVEL means the IF was not acquired after pretune: a source problem. Perform the *A4 Sampler/Mixer Check,* earlier in this section.

PHASE LOCK CAL FAILED means that a calculation of pretune values was not successful: a source or receiver failure. Perform the *Source Pretune Correction Constants* routine as outlined in the *Adjustments* section. If that routine fails, perform the *A4 Sampler/Mixer Check.*

PHASE LOCK LOST means that phase lock was lost or interrupted before the band sweep ended: a source problem. Refer to *Phase Lock Diagnostic Routines* next to access the phase lock loop diagnostic service routine. Then troubleshoot the problem by following the procedures in this section.

Phase Lock Diagnostic Routines

Perform the following steps to determine at what frequencies and bands the phase lock problem occurs.

1. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [PLL AUTO OFF]*** to turn off the automatic phase-locked loop. Normally, when the phase-locked loop detects lock problems, it automatically aborts the sweep and attempts to recalibrate the pretune cycle. Turning off PLL AUTO defeats this routine.
2. Press ***[PLL DIAG ON]*** to turn on the phase-locked loop diagnostic service mode. In this mode, the phase lock cycle and subsweep number are displayed on the CRT. (See "Service Modes" in the Troubleshooting Reference section for more information.)
3. Press ***[PLL PAUSE]*** to pause the phase lock sequence and determine where the source is trying to tune when lock is lost.

Refer to *Source Theory,* in *Theory of Operation,* for additional information regarding band related problems. Then use the procedures in this section to check source functions at specific frequencies.

HP 8753A PHASE LOCK ASSEMBLY COMPATIBILITY

Table 11 lists the procedures to follow when the various assemblies are replaced for all HP 8753A instruments. Note that these procedures do not include the post-repair adjustments or verification tests. The possible replacement assemblies for A3, A9, and A11 are listed in the first column. The actions needed to check for compatibility are listed in the other columns. To determine the appropriate action, find the part number of the assembly being installed and then follow the instructions in that row in numerical order. The letters at the end of the instructions refer to the detailed procedures given after the table.

Table 11. A3/A9/A11 Compatibility Procedures

Replacement Assembly	A3 Source Pretune Correction	A9 CPU	A11 Phase Lock
A3 Source 08753-60084 08753-69003	1) Run service test #48. (A) If pass then DONE; else do steps 2 and 3 and run test #48 again.	2) Upgrade firmware. (C)	3) Install jumper and apply label. (D)
A9 CPU 08753-60085 08753-69085	3) Run service test #48 (A)	1) Check firmware. (B) If Rev 1.00 then upgrade firmware. (C)	2) Install jumper and apply label if needed. (D)
A11 Phase Lock 08753-60101 08753-60086	2) Run service test #48 (A)	1) Check firmware. (B) If Rev 1.00 then upgrade firmware. (C)	
A11 Phase Lock 08753-60060 08753-69060		1) Check firmware. (B) If Rev 1.00 then done, else do step 2. (C)	2) Install jumper and apply label. (D)

DETAILED PROCEDURES

A. Run Service Test #48

Some adjustments are normally required after replacing the A3 source, A9 CPU, and A11 phase lock assemblies. One of these is service test #48, Source Pretune Correction Constants. To run this test, first move the A9 CPU jumper to the top (alter) position. Then, press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [8] [X1]** ***[EXECUTE TEST]***. Press ***[YES]*** when asked if it's okay to alter correction constants.

B. Check Firmware

Turn the power off and then on. The firmware revision number can be found right after "HP8753A" and will be in a form similar to 01.00 or 01.01. Another method is to remove the A9 CPU board and look at the labels of the socketed IC's. The label will indicate the revision number in the form of Rev 1.00 or Rev 1.01.

C. Upgrade Firmware

There is a firmware upgrade kit, HP part number 08753-60083, which provides the upgrade to revision 1.01 firmware. The kit includes the EPROMs along with service note 8753A-8 which explains how to install them. A jumper and label are also included to upgrade the A11 phase lock assembly.

D. Install Jumper and Apply Label if Needed

1. Remove the power line cord from the HP 8753A. With a #2 point pozidrive screwdriver, loosen the captive screw on the back edge of the top cover and remove the cover.
2. Remove the PC board stabilizer by removing the one screw in the center.
3. Locate the A11 Phase Lock assembly by referring to the location diagram. This can be found on the underside of the top cover.
4. Disconnect the SMB cable at A11J1 and remove the A11 assembly.
5. Check the part number of the board. If it is NOT 08753-60060 or 08753-69060, there is no need to install the jumper, so you are done. Otherwise, refer to Figure 27 to locate and remove A11R42.
6. Replace A11R42 with the jumper provided, HP part number 8159-0005.
7. Now relabel the A11 board with the label provided. The label, HP part number 7120-1232, should be placed over the current board number as shown in Figure 27.
8. Replace the A11 assembly, being sure to reconnect the SMB cable.

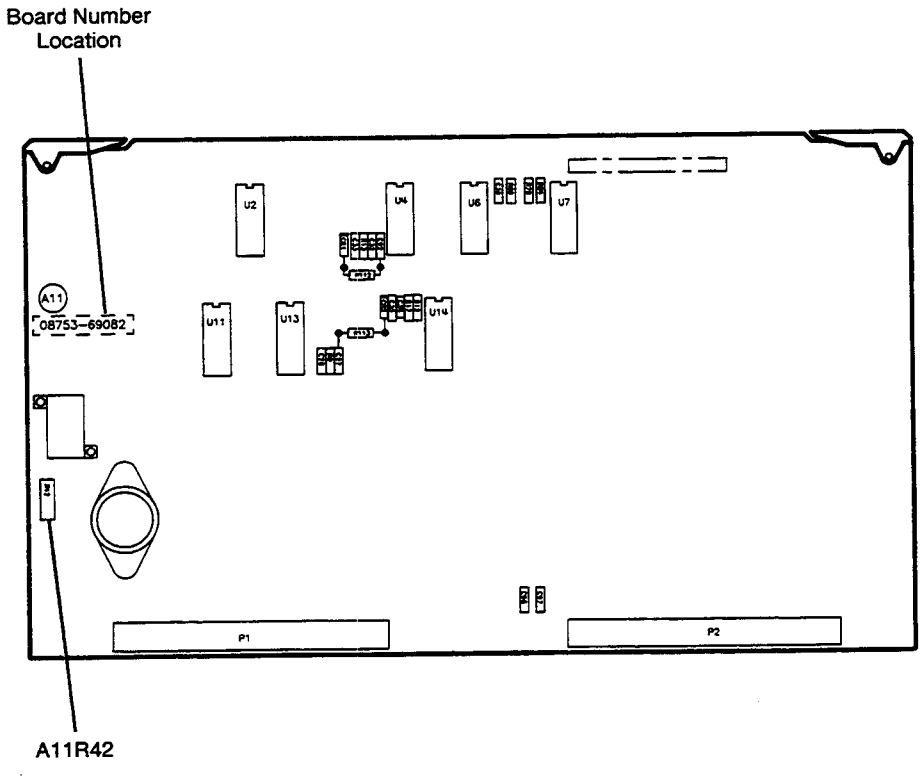


Figure 27. A11 Phase Lock Partial Component Location Diagram

REPAIR SEQUENCE

Troubleshooting: identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustment: how to adjust the replacement assembly

INTRODUCTION

The receiver group of the analyzer consists of the A4/5/6 sampler/mixer assemblies and the A10 digital IF assembly. The purpose of this section is to troubleshoot those four assemblies. The following procedures assume you have read *Isolate Faulty Group Troubleshooting*. Perform the procedures in the order given.

Table 1 is a summary of the receiver checks in this section. Experienced technicians need refer to little else. Others should begin troubleshooting at *Receiver Failure Error Messages* if the display indicates an overload or phase lock cal failure. If no error messages are visible, go to *Is Any Input Good?*.

Table 1. Receiver Group Troubleshooting Summary

This table summarizes the sequence of checks included in this section. The headings of the detailed procedures in this section are in bold print.

1. Troubleshoot **Receiver Failure Error Messages** by referring to that section.
2. **Is Any Input Good?** If so, go step 5.
3. **Troubleshooting When All Inputs Look Bad** begins with internal tests 18 and 17. If any fail, the A10 is probably faulty.
4. **Check the 4MHz REF Signal** at A10P2-6.

   If bad, check the signal source and path.

   If good, the A10 assembly is most probably faulty. **Check A10 by Substitution or Signal Examination.** The signals are listed in Table 2.
5. **Troubleshooting When One or More Inputs Look Good** begins with **Checking the 4 kHz Signal** at the points listed in Table 3.

   If the 4 kHz signal is good, **Check the Trace with the Sampler Correction Constants Off.**

   - If the trace does not improve, the A10 assembly is faulty.
   - If the trace improves, refer to the sampler diode bias adjustment and then perform the sampler magnitude and phase correction constant adjustment.

   If the 4 kHz signal is bad, **Check 1st LO Signal at Sampler/Mixer.**

   - If 1st LO is bad, check the A7 assembly and cable.
   - If 1st LO is good, **Check 2nd LO at Sampler/Mixer.** Determine whether the sampler/mixer or A12 assembly and signal path is faulty.

RECEIVER FAILURE ERROR MESSAGES

The two error messages which indicate receiver group problems may be caused by the instrument itself or by external devices or connections. Remember that RF OUT must be connected to input R to maintain phase lock (unless internal cables are moved). An explanation of each error message follows.

Overload on Input A (or B or R); Power Reduced

The maximum input power level is 0 dBm. The analyzer automatically reduces power to its minimum output level (less than −5 dBm) when power to an input exceeds about +2 to +5 dBm. This state of reduced power is called a power trip. It is signaled by P↓ in the status notation area on the left side of the CRT.

To reset the power trip and regain control of the power level, remove any devices under test which may have contributed excess power to the input. Connect RF OUT through a 20 dB attenuator and a power splitter to inputs R and A as shown in Figure 1. Then press **[MENU]** ***[POWER]*** **[0] [x1]** ***[POWER TRIP OFF]*** to return the power level to the preset state.

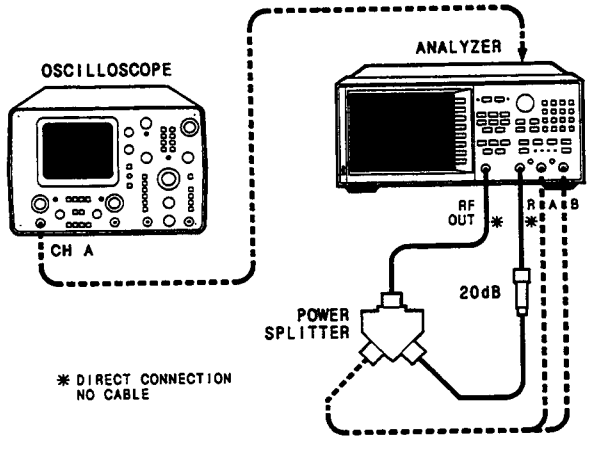


Figure 1. Receiver Troubleshooting Connection Diagram

If the power trip indicator (P↓) does not reappear, reconfigure the test setup to keep input power levels at 0 dBm or below.

If P↓ reappears, continue with *Is Any Input Good?*

IS ANY INPUT GOOD?

Good inputs produce traces similar to Figure 2. Bad inputs do not. Connect a power splitter and cables as shown in Figure 1. Press **[PRESET] [MKR] [5] [0] [M/u] [MEAS]** ***[R]*** to measure input R. Then measure inputs A and B (remember to move the RF cable from input A to input B when measuring input B). Observe the trace produced by each input.

If none of the three input traces looks good (like Figure 2), continue with *Troubleshooting When All Inputs Look Bad.*

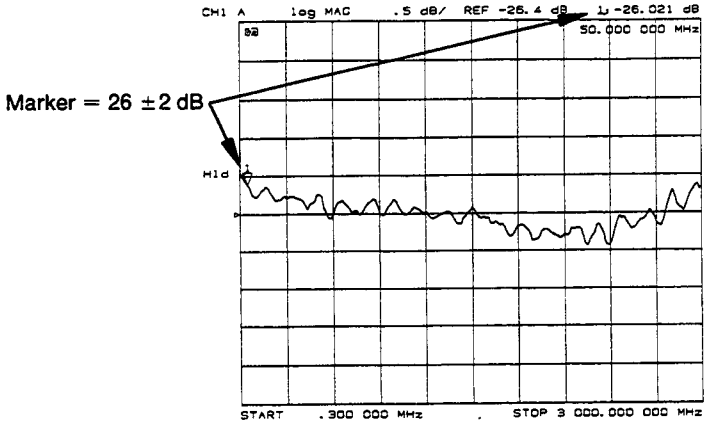


Figure 2. Typical Good Trace

If at least one input trace resembles Figure 2, continue with *Troubleshooting When One or More Inputs Look Good.*

TROUBLESHOOTING WHEN ALL INPUTS LOOK BAD

Run Internal Tests 18 and 17

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[1] [8] [x1]** ***[EXECUTE TEST]*** to run the ADC offset. At its conclusion press **[1] [7] [x1] [EXECUTE TEST]** to run the ADC linearity test.

If either of these tests FAIL, the A10 assembly is probably faulty. This can be confirmed by checking the 4 MHz signal and substituting the A10 assembly or checking the signals listed in Table 2.

Check 2nd LO

Check the 2nd LO signal. Refer to the *A12 Reference Check* part of *Source Troubleshooting* for analog bus and oscilloscope checks of the 2nd LO and waveform illustrations.

- If the checks pass, continue to *Check the 4 MHz REF Signal*.
- If the checks fail, perform the *High/Low Band Transition Adjustment*.
- If the adjustment fails, or brings no improvement, replace A12.

Check the 4 MHz REF Signal

Connect the RF OUT through a power splitter to inputs R and A. Press **[PRESET]** and use an oscilloscope to observe the 4 MHz REF signal at A10P2-6.

If the signal does not resemble Figure 3, troubleshoot the signal source (A12P2-36) and path.

If the signal is good, the probability is greater than 90% that the A10 assembly is faulty. For confirmation, perform the next check.

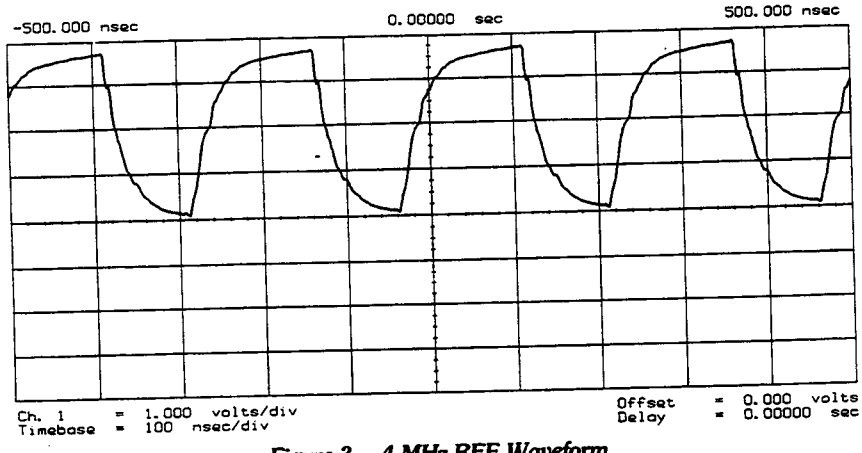


Figure 3. 4 MHz REF Waveform

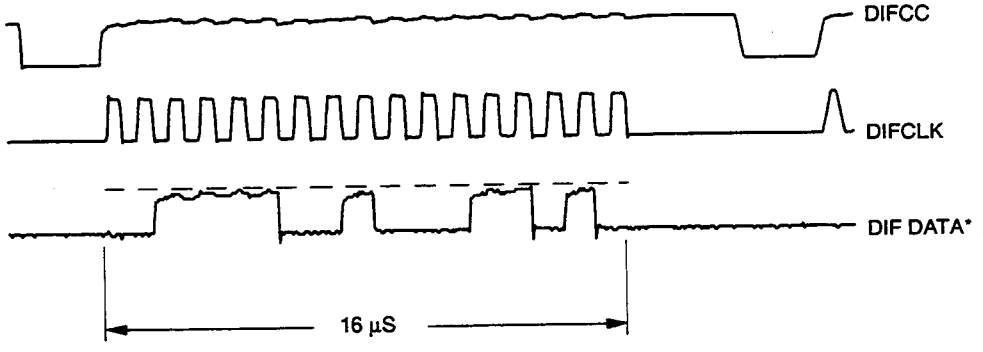
Check A10 by Substitution or Signal Examination

If the 4 MHz REF signal is good at the A10 assembly, check the A10 assembly by one of the following methods:

- Substitute another A10 assembly or
- Check the signal/control lines required for its operation. The pins and signal sources of those lines are identified in Table 2. It is possible that the A9 assembly may not be providing the necessary signals. These signal checks allow you to determine which assembly is faulty. Some of the waveforms are illustrated by Figures 4 and 5.

Table 2. Signals Required for A10 Assembly Operation

Mnemonic	Description	A10 Location	Signal Source	See Figure
DIFD0	Digital IF data 0 (LSB)	P2-27	A9P2-27	*
DIFD1	Digital IF data 1	P2-57	A9P2-57	*
DIFD2	Digital IF data 2	P2-28	A9P2-28	*
DIFD3	Digital IF data 3	P2-58	A9P2-58	*
DIFD4	Digital IF data 4	P2-29	A9P2-29	*
DIFD5	Digital IF data 5	P2-59	A9P2-59	*
DIFD6	Digital IF data 6	P2-30	A9P2-30	*
DIFD7	Digital IF data 7 (MSB)	P2-60	A9P2-60	*
L DIFEN0	Digital IF enable 0	P2-34	A9P2-34	*
L DIFEN1	Digital IF enable 1	P2-5	A9P2-5	*
L DIFEN2	Digital IF enable 2	P2-35	A9P2-35	*
DIFCC	Digital IF conversion comp.	P2-33	A10P2-33	4
DIFCLK	Digital IF serial clock	P2-4	A10P2-4	4
DIF DATA	Digital IF serial data out	P2-3	A10P2-3	4
L ENDIF	L=enable digital IF	P2-17	A9P2-17	5
L INTCOP	L=interrupt, DSP	P2-2	A10P2-2	5
*Check for TTL activity.				



*DIF DATA consists of 16 serial bits per input conversion.
The LSB is on the right side and is the most volatile.

Figure 4. Digital Data Lines Observed Using L INTCOP as Trigger

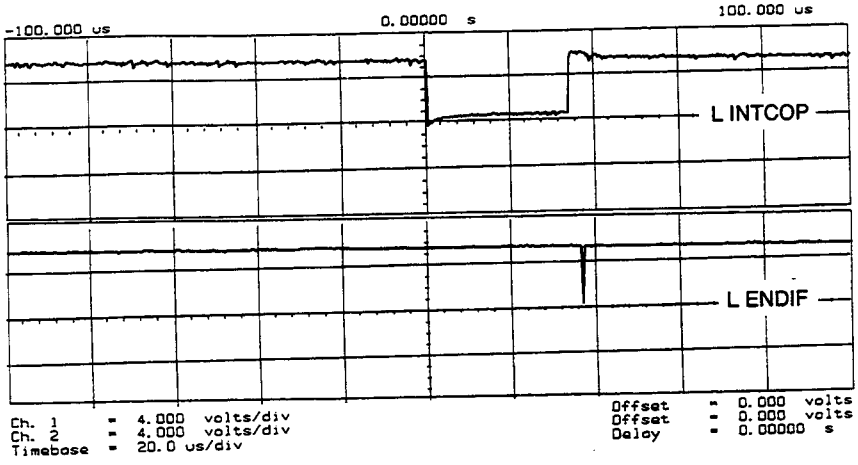


Figure 5. Digital Control Lines Observed Using L INTCOP as Trigger

If the substitute assembly is no improvement or if all of the input signals are valid, continue with *Check the 4 kHz Signal*. Otherwise troubleshoot the suspect signal(s) or consider the A10 assembly faulty.

TROUBLESHOOTING WHEN ONE OR MORE INPUTS LOOK GOOD

Since at least one input is good, all of the common receiver circuitry beyond the multiplexer is functional. Only the status of the individual sampler/mixers and their individual signal paths is undetermined.

Check the 4 kHz Signal

Connect the RF OUT of the analyzer to input R and the suspect input. Press **[PRESET] [MENU]** ***[CW FREQ]*** and check the 4 kHz output of the suspect sampler/mixer at the A10 assembly. The input and output access pins are listed in Table 3. The signal should resemble the waveform of Figure 6.

If the signal is good, examine the trace with the sampler correction constants turned off, as described below.

If the signal is bad, perform the *Check 1st LO Signal at Sampler/Mixer* procedure.

Table 3. 2nd IF (4 kHz) Signal Locations

Mnemonic	Description	A10 Location	Signal Source
IFR	4 kHz	A10P1-1, 31	A4P1-6
IFA	4 kHz	A10P1-4, 34	A5P1-6
IFB	4 kHz	A10P1-7, 37	A6P1-6

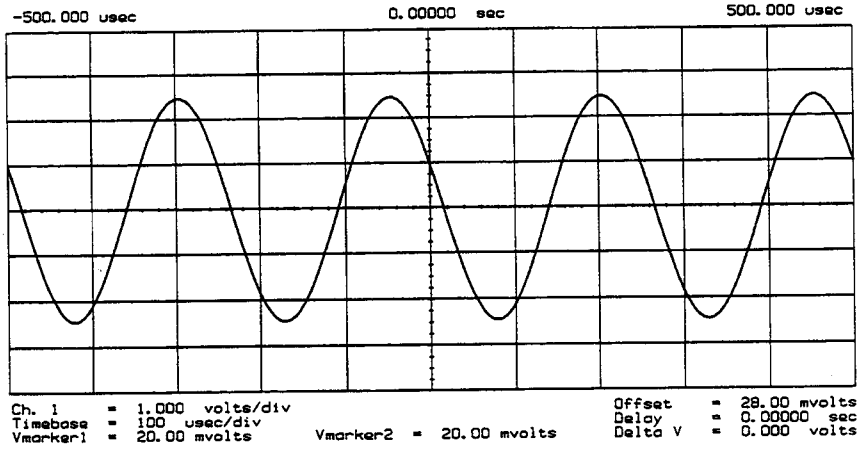


Figure 6. 2nd IF (4 kHz) Waveform

Check the Trace with the Sampler Correction Constants Off

Press **[SYSTEM]** ***[SERVICE MENU] [MORE] [SAMPLER COR OFF]*** and see whether the trace improves. The trace should resemble Figure 7(b). Note that when the correction constants are turned off, an absolute offset and bandswitch points may be evident.

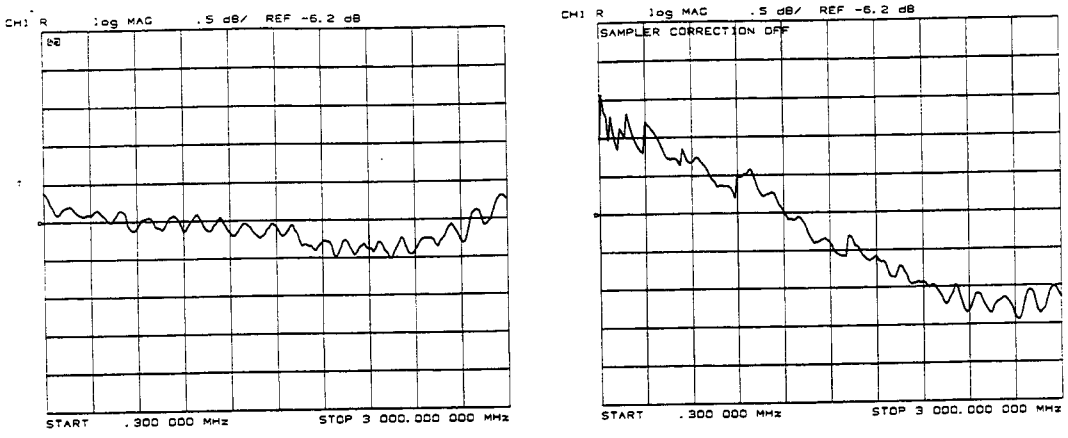

CH1 R log MAG .5 dB/ REF -6.2 dB
START .300 000 MHz
STOP 3 000.000 000 MHz
a.
CH1 R log MAG .5 dB/ REF -6.2 dB
SAMPLER CORRECTION OFF
START .300 000 MHz
STOP 3 000.000 000 MHz
b.

Figure 7. Typical Trace with Sampler Correction On and Off

If the trace shows no improvement with the sampler correction constants turned off, the A10 assembly is defective.

If the trace shows an improvement, refer to *Sampler Diode Bias Adjustment* (HP 8753A only). Then, for all anlayzers, perform the *Sampler Magnitude and Phase Correction Constants* adjustment. They are in the *Adjustments* section.

If the trace remains bad after this adjustment, the A10 assembly is defective.

Check 1st LO Signal at Sampler/Mixer

If the 4 kHz signal is bad at the sampler/mixer assembly, check the 1st LO. Substitute A7 outputs and cables to the sampler/mixer in question. The suspect components are traces on the A7 assembly, the cable and associated jacks and connectors.

- If the 1st LO is bad, check the A7 assembly and cable.
- If the 1st LO is good, continue with the 2nd LO check.

Check 2nd LO Signal at Sampler/Mixer

Check the 2nd LO signal at the pins identified in Table 4. Refer to the *A12 Reference Check* part of *Source Troubleshooting* for analog bus and oscilloscope checks of the 2nd LO and waveform illustrations. Table 4 identifies the signal location at the samplers and the A12 assembly.

Table 4. 2nd LO Locations

Mnemonic	Description	Sampler Location	Signal Source
2nd LO 1	2nd LO (0 degrees)	A4/5/6 P1-11	A12P1-2, 32
2nd LO 2	2nd LO (−90 degrees)	A4/5/6 P1-4	A12P1-4, 34

If the 2nd LO is good at the sampler/mixer, the sampler/mixer assembly is bad. Otherwise troubleshoot the A12 assembly and associated signal path.

INTRODUCTION

In a broad sense, measurement failures can be divided into two categories:

- Soft failures which don't affect the normal functioning of the analyzer but render incorrect measurement data.
- Hard failures which impede the normal functioning of the analyzer or prohibit the use of a feature.

The emphasis of this troubleshooting section is soft failures. Soft failures are usually caused by operator errors, faulty calibration devices or connectors, bad cables, improper calibration techniques, or RF cabling problems within the test set.

At this time, the analyzer itself is assumed to be free of hard failures _ it passed the previous checks provided in *Isolate Faulty Group*. Any remaining anomaly must be a soft failure or a failure outside of the analyzer. Read the following paragraphs, *Possible Operation Problems*; then continue with the following:

- *Inspect the Accessories* to troubleshoot possible connector, test set switch, cable, or calibration devices problems, or
- *Test Set Problems* to troubleshoot other possible tset set problems.
- *Lightwave System Problems* to troubleshoot problems of lightwave component analyzer systems.

POSSIBLE OPERATION PROBLEMS

The following "problems" are inherent in the system hardware. The solution is to read the explanations below.

Full 2-Port Calibration Measurement Discrepencies

Two facts explain most discrepencies:

- All four S-parameters must be measured to extract a single S-parameter from a DUT,
- All four S-parameters are not measured by HP 85046 and 85047 test sets with each sweep unless triggered, or the test set is equipped with a solid-state transfer switch.

To trigger the system to make valid measurements, especially important after adjusting a DUT, press **[MENU]** ***[MEASUREMENT RESTART]*** or **[MENU]** ***[TRIGGER MENU] [NUMBER of GROUPS]*** and enter the number of (groups of) sweeps desired.

After each DUT adjustment, the system must make another complete sweep (forward and reverse, the test set LEDs should toggle).

Mechanical switches preclude limitless toggling. Refer to the analyzer *Operating Manual* or the test set manual for more detail.

"Loose" Test Port Connectors

Port 1 of the HP 85046A/B and 85047A test sets has been designed to mechanically "float". This allows unstressed connections to rigid transistor test fixtures.

Odd Appearing Opens and Shorts

Opens and shorts may appear as short lines, rather than the expected points, on a Smith chart. This is a result of some shorts and opens being offset. Refer to the calibration kit manual to determine the offset. See *Verify Shorts and Opens*, below, for more information.

Mating 75 Ohm Connectors with 50 Ohm Connectors

Do not mate 50 ohm connectors with 75 ohm connectors; their center conductors are different diameters. Mating a 50 ohm male connector with a 75 ohm female connector will destroy the female.

INSPECT THE ACCESSORIES

Accessories troubleshooting is organized in three major sections. It is suggested that the procedures be performed in the order given:

1. Inspect and Gage Connectors: Check the physical condition of the analyzer front panel connectors, calibration kit devices, and test set connectors.
2. Switch Repeatability: Check the operation of the mechanical transfer switch in the test set.
3. Inspect Error Terms: Use the error terms to isolate faulty components and troubleshoot.

Inspect and Gage Connectors

1. Inspect the front panel connectors on the analyzer. Check for bent or broken center pins and loose connector bulkheads.

   Gage the connectors. (Gage kits are listed in Table 1 of the *Service and Equipment Overview* section.) The specified front panel type-N connector center pin **protrusion** is 0.201 to 0.207 inch.

   If the center pin protrusion is incorrect, replace the entire connector assembly (see *Replacement Procedures* and Figure 10 in *Replaceable Parts*).

2. Inspect the calibration kit devices for bent or broken center conductors and other physical damage. Gage each device. The mechanical specifications for each device are given in the calibration kit manual.

   If any calibration device is out of mechanical tolerance, replace the device.

3. Inspect and gage test set and power splitter connectors as above.

Switch Repeatability

Calibration does not compensate for the repeatability of the mechanical transfer switch in the S-parameter test sets, so the switch can be a source of error. However, most switch failures are not subtle: no action.

Connect the test set to the analyzer. Press **[PRESET] [MEAS]** ***[Refl: REV S22 (B/R)]*** and then ***[Refl: FWD S11 (A/R)]***. Listen for the sound of the switch.

- No sound: confirm that the test set does not have a solid-state (noiseless) switch, then refer to *Test Set Troubleshooting* to locate the problem.
- Audible sound: continue with this section unless a subtle failure is suspected. To troubleshoot subtle failures, refer to the test set manual.

Inspect Error Terms

Error terms are basically a measure of a "system": a network analyzer, test set or power splitter, and calibration kit and any cables used. As required, refer to the *Error Terms* troubleshooting section for the following:

- The specific measurement calibration procedure used to generate the error terms.
- The routines required to extract error terms from the instrument.
- Typical error term data.

Use Table 1 to cross-reference error term data to system faults.

Table 1. Components Related to Specific Error Terms

Component	Direc-tivity	Source Match	Refl't'n Tracking	Isolation	Load Match	Trans-mission Tracking
Cal Kit						
load	x					
open/short	x	x				
Test Set						
connectors	x	x	x	x	x	x
bridge	x	x	x	x	x	x
bias tee		x	x	x	x	x
transfer switch	x	x	x	x	x	
step attenuator		x	x		x	x
power splitter		x	x		x	x
Analyzer						
Sampler			x	x		x
A10 digital IF				x		
External cables					x	x

If problems are detected using error term analysis, use the following approach to isolate the fault:

1. Check the cable by examining the load match and transmission tracking terms. If those terms look suspicious, go to *Cable Test*.

2. Verify the cal kit devices:

   Loads: If the directivity error term looks good, the load and the port are good. If directivity looks bad, connect the same load on the other port and measure its directivity. If the second port looks bad, as if the problem had shifted with the load, replace the load. If the second port looks good, as if the load had not been the problem, troubleshoot the first port by refering to the test set manual.

   Shorts and opens: If the source match and reflection tracking terms look good, the shorts and the opens are good. If these terms look bad while the rest of the terms look good, proceed to *Verify Shorts and Opens*. If other error terms also indicate a problem, refer to the test set manual.

Cable Test

The load match error term is a good indicator of cable problems. Further verification of cable faults can be achieved by measuring the reflection of the cable. Perform an S11 1-port calibration directly at port 1 (no cables). Then connect the suspect cable to port 1 and terminate the open end in 50 ohms.

Figure 1 shows the return loss trace of a good (left side) and poor cable. Note that the important characteristic of a cable trace is its level (the good cable trace is much lower) not its regularity. Refer to the cable manual for return loss specifications.

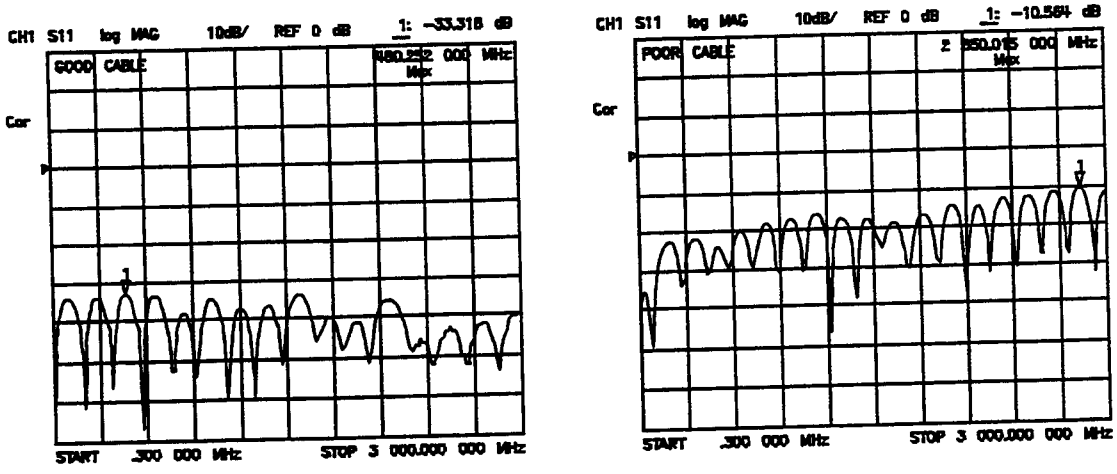

CH1 S11 log MAG 10dB/ REF 0 dB
GOOD CABLE
Cor
START .300 000 MHz
STOP 3 000.000 000 MHz
CH1 S11 log MAG 10dB/ REF 0 dB
POOR CABLE
Cor
START .300 000 MHz
STOP 3 000.000 000 MHz

Figure 1. Typical Return Loss Traces of Good and Poor Cables

Verify Shorts and Opens

Substitute a known good short and open of the same connector type and sex as the short and open in question. If the devices are not from one of the standard calibration kits, refer to *Modifying Calibration Kits* in Chapter 5 of the *Reference* to use the ***[MODIFY CAL KIT]*** function. Set aside the short and open that are causing the problem.

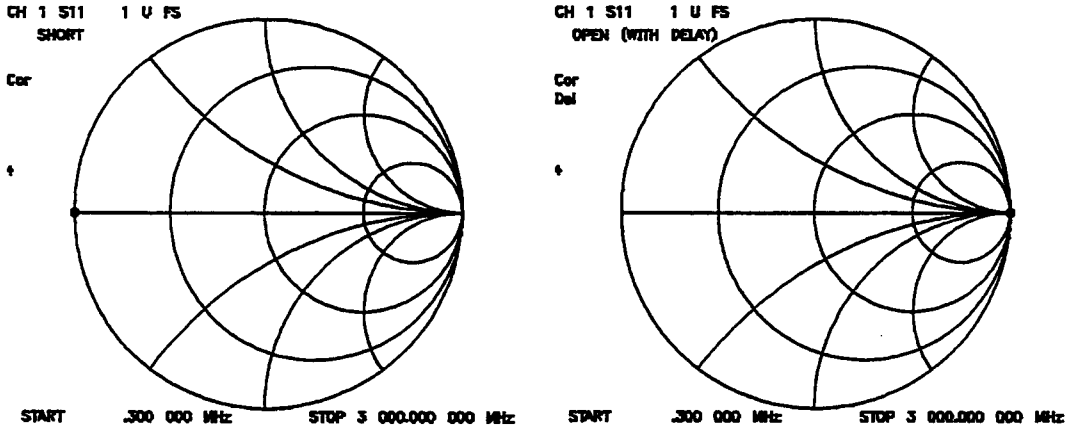
1. Perform an S11 1-port calibration using the good short and open. Then press **[FORMAT]** ***[SMITH CHART]*** to view the devices in Smith chart format.

2. Connect the good short to port 1. Press **[SCALE REF]** ***[ELECTRICAL DELAY]*** and turn the RPG to enter enough electrical delay so that the trace appears as a dot at the left side of the circle (see Figure 2a, left).

   Replace the good short with the questionable short at port 1. The trace of the questionable short should appear very similar to the known good short.

3. Connect the good open to port 1. Press **[SCALE REF]** ***[ELECTRICAL DELAY]*** and turn the RPG to enter enough electrical delay so that the trace appears as a dot at the right side of the circle (see Figure 2b, right).

   Replace the good open with the questionable open at port 1. The trace of the questionable open should appear very similar to the known good open.



a. b.

Figure 2. Typical Smith Chart Traces of Good Short (a) and Open (b)

TEST SET PROBLEMS

Test set problems are of three varieties: RF problems, power problems and control problems. The HP 85044A/B can only experience RF problems as it is not powered or controlled by the analyzer.

To troubleshoot:

- The HP 85044A/B: refer to its manual.
- S-parameter test set RF problems: refer to their manuals.
- S-parameter power or control problems: continue with the next paragraph (power problems can affect control).

Troubleshooting Power Problems in S-Parameter Test Sets

A. HP 8753C or 8702B with HP 85047A or 85046A/B

Do *not* connect the test set to the analyzer to perform these checks.

1. Move the A9CC jumper to the "alter" position.
2. First press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [PEEK/POKE ADDRESS]*** **[1314412] [x1].**
3. Now "POKE" the address for the appropriate test set:
   - HP 85047A – Press ***[POKE]*** **[5] [x1] [PRESET]**
   - HP 85046A/B – Press ***[POKE]*** **[1] [x1] [PRESET]**
4. Measure the DC voltage at pin 14 (see Figure 3) of the analyzer rear panel test set interconnect connector.

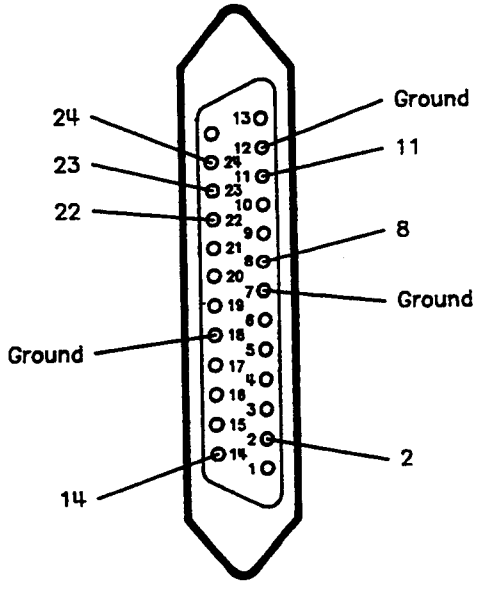


Figure 3. Analyzer Rear Panel Test Set Interconnect Connector Pins

- If the voltage is between 21.3V and 22.7V: the supply is good, do either of the following:
- Refer to the test set manual to troubleshoot the test set and its interconnect cable (especially if the test set LEDs don't light).

- Continue with *Troubleshooting Control Problems in S-Parameter Test Sets.*

- If the voltage is not as stated above, refer to the *Power Supply* troubleshooting section earlier in this manual.

5. Be certain to press ***[POKE]*** **[0] [x1] [PRESET]** after all troubleshooting and return the A9CC jumper to "normal" position.

B. HP 8753B or 8702A with HP 85047A

Do *not* connect the test set to the analyzer to perform these checks.

1. Move the A9CC jumper to the "alter" position.

2. Follow the procedure to measure the DC voltage at pin 14 given for the HP 8753C and 8702B except as follows:

   - In step 2, press ***[POKE]*** **[1] [x1]** (instead of **[5] [x1]**).

3. Be certain to press ***[POKE]*** **[0] [x1] [PRESET]** after all troubleshooting and return the A9CC jumper to "normal" position.

C. HP 8753A/B or 8702A with HP 85046A/B

This combination of analyzer and S-parameter test set cannot be tested in the same way as the others. There is no "POKE" address which allows this analyzer to function as if the test set were connected.

To measure the DC voltages, refer to the HP 85046A/B operating and service manual. Measure the voltages on the logic assembly board. Refer to step 4 of part A for the procedures to follow for correct or for incorrect voltages.

Troubleshooting Control Problems in S-Parameter Test Sets

The analyzer controls the test set attenuator, the transfer switch (for forward and reverse measurements), and, in the case of the HP 85047A, the frequency doubler. The associated test set interconnect connector pins are shown in Figure 3; refer to it as needed.

NOTE: Before continuing with these procedures, be sure the A9CC jumper is set to "alter" and the value for the appropriate test set has been "POKEd".

Attenuation Control Voltages. Voltage levels on the pins identified in Table 2 control test set attenuation. Press **[MENU]** ***[POWER] [ATTENUATOR PORT 1]*** and enter the attenuation values listed below. After each entry, check the pins (see Figure 3) for the indicated voltages.

Table 2. Attenuation Voltage Matrix

Attenuation	HP 85046A/B			HP 85047A			
	PIN 11	PIN 22	PIN 23	PIN 8	PIN 11	PIN 22	PIN 23
0	+5	+5	+5	+5	+5	+5	+5
10	+5	0	+5	+5	+5	0	+5
20	+5	+5	0	+5	+5	+5	0
30	+5	0	0	+5	+5	0	0
40	0	+5	+5	+5	0	+5	+5
50	0	0	+5	+5	0	0	+5
60	0	+5	0	+5	0	+5	0
70	0	0	0	+5	0	0	0

- Proper voltages: refer to the test set manual to continue troubleshooting. For HP 85047A systems, first see *HP 85047A Note*
- Wrong voltages: replace the A16 rear panel assembly of the analyzer.

Measurement Control Signals. Voltage levels on the pins identified in Table 3 control measurement direction (forward or reverse) and the doubler function (on or off). Press **[MEAS]** ***[S-PARAMETERS]*** and enter the measurements listed below. After each entry, check the pins (see Figure 3) for the indicated voltages. In similar fashion, change the frequency range (to 6 GHz or 3 GHz) by pressing **[SYSTEM]** ***[FREQ RANGE 3GHz6GHz]*** and check the pins for the indicated voltages.

Table 3. Measurement Voltage Matrix

	HP 85046A/B	HP 85047A		
	Pin 8	8	22	23
S11 (A/R)	+5	0	–	+5
S21 (B/R)	+5	0	–	+5
S12 (B/R)	0	0	–	0
S22 (A/R)	0	0	–	0
Doubler ON	–	0	0	–
Doubler OFF	–	0	+5	–

- Proper voltages: refer to the test set manual to continue troubleshooting. For HP 85047A systems, first see *HP 85047A Note*, above, to reset the analyzer.
- Wrong voltages: replace the A16 rear panel assembly of the analyzer.

Remote Trigger. Monitor pin 24 with an oscilloscope. Press **[PRESET]**: +5V should be present during PRESET. After PRESET a negative-going pulse (to zero volts, about 200 nanoseconds) should be visible. The pulse should be present at the beginning of each sweep. (To increase pulse visibility, decrease number of points to 3 and decrease sweep time to 50 milliseconds on the analyzer.)

- Proper pulse: troubleshoot the test set by referring to its manual. For HP 85047A systems, first see *HP 85047A Note*, above, to reset the analyzer.
- Incorrect pulse: replace the analyzer A16 rear panel assembly.

Sweep Delay. This signal delays the start of the analyzer's sweep to allow for test set switch settling time. It also distinguishes, by encoding, the HP 85047A from the 85046A/B test sets. See the test set manual for more detail. For HP 85047A systems, first see *HP 85047A Note*, above, to reset the analyzer.

LIGHTWAVE SYSTEM PROBLEMS

Lightwave Source, Receiver, or Coupler problems

Refer to their specific manuals and perform the Performance Tests that verify their specified operation. Those tests will determine if the accessory needs repair. Repair for these three accessories must be performed by Hewlett-Packard.

Other Problems

Lightwave systems can have problems that are almost non-detectable using any troubleshooting tests. Here are some possible problems that can be checked if the failure is not isolated by the steps above:

- Wrong calibration kit or data being used.
- Cal kit re-defined without your knowledge.
- Fiber misalignment, poor splices in DUTs, breaks.
- Gel remaining on a connector.
- Fiber end-faces damaged or faulty.
- SMF and MMF mixed.

This section describes the functions of the Service Key menus. These menus are used to test, verify, adjust, control and troubleshoot the instrument. They are divided into two groups: internal diagnostics and service features. When applicable, the HP-IB mnemonic is written in parentheses following the key. See *HP-IB Service Mnemonic Definitions* at the end of this section.

INTERNAL DIAGNOSTICS SUMMARY

The internal diagnostics menus are shown in Figure 1 and described in the following paragraphs. The internal diagnostics keys are ***[TESTS]***, ***[TEST OPTIONS]*** and ***[SELF-DIAGNOSE]***.

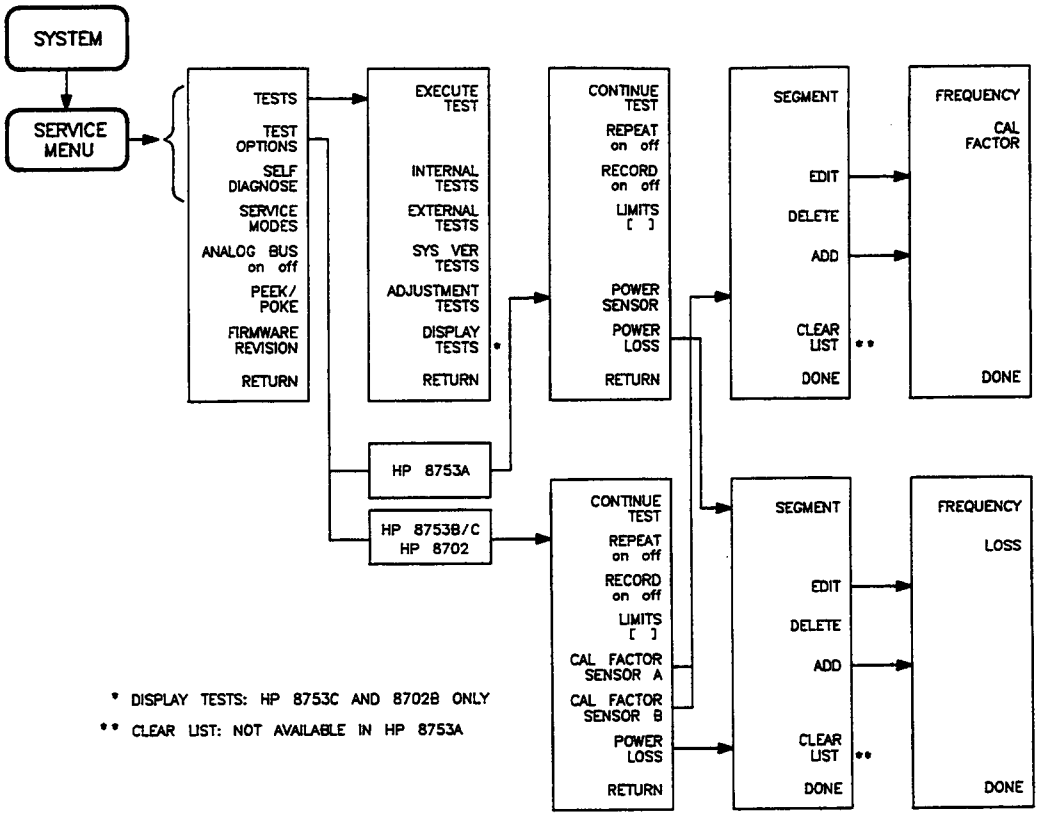


Figure 1. Internal Diagnostics Menus
(See Figure 2 for Service Feature Menus.)

NOTE: Throughout this service manual, these conventions are observed:

[HARDKEYS], labeled front panel keys, appear in bold,
[SOFTKEYS], CRT defined keys (in the bezel), appear in bold italics,
(HP-IB COMMANDS), when applicable, follow the keystroke in parentheses.

TESTS MENU

[TESTS] (TEST[D]). This softkey makes TEST the active function and accesses a menu that can be used to select or execute the service tests. The default is to internal test 1.

The tests are divided by function into the categories described below. To access the first test in each category, press the category softkey. To access the other tests, use the numeric keypad, step keys or knob. The test number, name, and status abbreviation will be displayed in the active entry area of the CRT.

Table 1 shows the test status abbreviation that appears on the CRT, its definition, and the equivalent HP-IB code. The HP-IB command to output the test status of the most recently executed test is OUTPTESS. Refer to *HP-IB Service Mnemonic Definitions* at the end of this section for more information.

Table 1. Test Status Terms

CRT Abbreviation	Definition	HP-IB Code
PASS	PASS	0
FAIL	FAIL	1
-IP-	IN PROGRESS	2
(NA)	NOT AVAILABLE	3
-ND-	NOT DONE	4
DONE	DONE	5

[EXECUTE TEST] (EXET). This runs the selected test and may display these softkeys:

[CONTINUE] (TESR1) continues the selected test.
[YES] (TESR2) alters correction constants during adjustment tests.
[NEXT] (TESR4) displays the next choice.
[SELECT] (TESR6) chooses the option indicated.
[ABORT] (TESR8) terminates the test and returns to the tests menu.

NOTE: Descriptions of tests in each of the categories are given under the heading *Test Descriptions* in the following pages.

[INTERNAL TESTS]. These tests are completely internal and self-evaluating. They do not require external connections or user interaction.

[EXTERNAL TESTS]. These are additional self-evaluating self-tests. However, these require some user interaction (such as keystrokes).

[SYS VER TESTS]. These tests are part of the system verification procedure, and are also used to examine the contents of the measurement calibration arrays. The procedure is in the *On-Site Verification* section. Information about the calibration arrays is provided in the *Error Terms* section.

[ADJUSTMENT TESTS]. These tests generate and store the correction constants; refer to *Adjustments*.

[DISPLAY TESTS]. These tests, for HP 8753C and 8702B only, check for proper operation of the GSP board.

TEST OPTIONS MENU

Note the minor differences between the menus for each instrument.

[TEST OPTIONS] accesses softkeys that affect the way tests (routines) run, or supply necessary additional data.

[CONTINUE TEST] (TESR1). This restarts the test where it was stopped.

[REPEAT on OFF] (TO2). This toggles the repeat function on and off. When ON, the selected test will run 10,000 times unless stopped by pressing any key. The current number of passes and fails is displayed on the CRT.

[RECORD on OFF] (TO1). This toggles the record function on and off. When ON, certain test results are sent to a printer via HP-IB. This is especially useful for correction constants. Remember, the instrument must be in system controller mode or pass control mode to print (refer to Chapter 7 of the *Operating and Programming Reference*).

[LIMITS] Selects either NORMal or SPECial (tighter) limits for the Operator's Check. The SPEC limits are useful for a guard band.

[POWER SENSOR]. HP 8753A only: accesses the Edit List menu, following, to allow modification of the power sensor calibration data table.

[CAL FACTOR SENSOR A] (CALFSENA). Same as ***[POWER SENSOR]***.

[CAL FACTOR SENSOR B] (CALFSENB). Same as ***[POWER SENSOR]***.

[POWER LOSS] (POWLLIST). Accesses the Edit List menu, following, to allow modification of the external power loss data table.

EDIT LIST MENU

Note the minor difference between the menus for each instrument.

[SEGMENT]. Selects a segment (frequency point) to be edited, deleted from, or added to the current data table. Works with the entry controls.

[EDIT] (SEDI[D]). Allows modification of frequency, cal factor and loss values previously entered in the current data table.

[DELETE] (SDEL). Deletes frequency, cal factor and loss values previously entered in the current data table.

[ADD] (SADD). Adds new frequency, cal factor and loss values to the current data table up to a maximum of 12 segments (frequency points, PTS).

[CLEAR LIST] (CLEL). Not available in the HP 8753A: deletes the entire current data table (or list) when ***[YES]*** is pressed. Press ***[NO]*** to avoid deletion.

[DONE] (EDITDONE). Returns to the previous menu.

SELF DIAGNOSE SOFTKEY

[SELF DIAGNOSE] examines in order the pass/fail status of all internal tests and displays "NO FAILURE FOUND" if no tests have failed.

If a failure is detected, the routine displays the assembly or assemblies most probably faulty and assigns a failure probability factor to each assembly.

TEST DESCRIPTIONS

The analyzer has up to 79 internal test routines that test, verify, and adjust the instrument. This section describes those tests.

Internal Tests

This group of tests runs without external connections or operator interaction. All return a PASS or FAIL condition. All run on power-up and PRESET except as noted.

0 **ALL INT**. This runs only when selected. It consists of internal tests 3-11, 13-16, and 20. If any of these tests fail, this test displays a FAIL status. Use the RPG knob to scroll through the tests and see which failed. If *all* pass, the test displays a PASS status. Each test in the subset retains its own test status.

1 **PRESET**. This runs the following subset of internal tests: first, the ROM/RAM tests 2, 3, and 4; then tests 5 through 11, 14, 15, and 16. If any of these tests fail, this test returns a FAIL status. Use the RPG knob to scroll through the tests and see which failed. If *all* pass, this test displays a PASS status. Each test in the subset retains its own test status. This same subset is available over HP-IB as "TST?". It is not performed upon remote preset.

2 **ROM**. This test is part of the ROM/RAM tests and cannot be run separately. Refer to the *Digital Control* troubleshooting section for more information. If there is no FAIL message after preset or power-on, the test has passed.

3 **CMOS RAM**. Part of the ROM/RAM tests, this test verifies the A9 CPU CMOS (long-term) memory with a non-destructive write/read pattern that does not erase data. If a FAIL message is not displayed, the test has passed. A destructive version that writes over stored data is documented in *ROM/RAM Tests* at the end of this section.

4 **Main DRAM**. Part of the ROM/RAM tests, this verifies the A9 CPU main memory (DRAM) with a non-destructive write/read test pattern. If a FAIL message is not displayed, the test has passed. A destructive version is documented in *ROM/RAM Tests* at the end of this section.

5 **DSP Wr/Rd**. This verifies the ability of the main processor and the DSP (digital signal processor), both on the A9 CPU assembly, to communicate with each other through DRAM. Verifies that programs can be loaded to the DSP. Verifies most of the main RAM access circuits.

6 **DSP RAM**. This verifies the A9 CPU RAM associated with the digital signal processor by using a write/read pattern.

7 **DSP ALU.** This verifies the A9 CPU high-speed math processing portions of the digital signal processor.

8 **DSP Intrpt**. This tests the ability of the A9 CPU digital signal processor to respond to interrupts from the the A10 digital IF ADC.

9 **DIF Control**. This tests the ability of the A9 CPU main processor to write/read to the control latches on the A10 digital IF.

10 **DIF Counter**. This tests the ability of the A9 CPU main processor to write/read to the triple divider on the A10 CPU. It primarily tests the A9 CPU data buffers and A10 digital IF, but it also requires the 4 MHz clock from the A12 reference to pass.

11 **DSP Control**. This tests the ability of the A9 CPU digital signal processor to write to the control latches on the A10 digital IF. Feedback is verified by the main processor. It primarily tests the A10 digital IF, but failures may be caused by the A9 CPU.

12 **Fr Pan Wr/Rd**. This runs only when selected. It tests the ability of the A9 CPU main processor to write/read to the front panel processor. It primarily tests the A2 front panel interface and processor, with interrupts, but also requires A9 CPU data buffering and address decoding. (See also tests 23 and 24 below.)

13 **Rear Panel**. This runs only when selected or with ALL INTERNAL. It tests the ability of the A9 CPU main processor to write/read to the rear panel control elements. It mostly tests the A16 rear panel, but also requires A9 CPU data buffering and address decoding. (It does *not* test the HP-IB interface; for that see the *HP-IB Programming Guide.*)

14 **Post Reg**. This polls the status register of the A8 post-regulator, and flags these conditions: heat sink too hot, inadequate air flow, or post-regulated supply shutdown.

15 **Frac N Cont**. This tests the ability of the A9 CPU main processor to write/read to the control element on the A14 fractional-N (digital) assembly. The control element must be functioning, and the fractional-N VCO must be oscillating (although not necessarily phase-locked) to pass.

16 **Sweep Trig**. This tests the sweep trigger (L SWP) line from the A14 fractional-N to the A10 digital IF. L SWP synchronizes the receiver with the sweep.

17 **ADC Lin**. This runs only when selected. It tests the linearity of the A10 digital IF ADC using the built-in ramp generator. The test generates a histogram of the ADC linearity, where each data point represents the relative "width" of a particular ADC code. Ideally, all codes have the same width; different widths correspond to non-linearities.

18 **ADC Ofs**. This runs only when selected. It tests the ability of the offset DAC on the A10 digital IF to apply a bias offset to the IF signals before the ADC input. Primarily tests the A10 digital IF.

19 **ABUS Test**. This runs only when selected. It measures several analog bus reference voltages (all nodes from the A10 digital IF) to test analog bus accuracy. It primarily tests the A10 digital IF.

20 **FN Count**. This test uses the internal counter to count the A14 fractional-N VCO frequency (120 to 240 MHz) and the divided fractional-N frequency (100 kHz). It requires the 100 kHz signal from A12 and the counter gate signal from A10 to pass.

External Tests

These tests require either external equipment and connections or operator interaction of some kind to run. Tests 23 and 24 are comprehensive front panel checks, more complete than test 12, that check the front panel keys and knob.

21 **R&A Op Check.** This test and the next are used in the *Operator's Check* procedure. The *Operator's Check* is documented in the *Troubleshooting* section of this manual. It requires the external connection of an attenuator and power splitter and it tests input R, input A and the phase lock system.

22 **R&B Op Check.** Same as 21, but tests input B (instead of A).

23 **Fr Pan Seq.** This tests the RPG and all A1 front panel keys, as well as the front panel microprocessor on the A2 assembly. It prompts the user to rotate the RPG, then press each key in an ordered sequence. It continues to the next prompt only if the current prompt is correctly satisfied.

24 **Fr Pan Diag.** Similar to 23 above, but the user rotates the RPG or presses the keys in any order, and this test displays the command the instrument received.

25 **ADC Hist.** Factory use only.

26 **Source Ex.** Factory use only.

Sys Ver Tests

These tests apply mainly to system-level, error-corrected verification and troubleshooting. Tests 27 to 31 are associated with the system verification procedure, documented in the *On-Site Verification* section. Tests 32 to 43 facilitate examining the calibration coefficient arrays (error terms) resulting from a measurement calibration; refer to the *Error Terms* section for details.

27 **Sys Ver Init.** This recalls the initialization state for system verification from disk, in preparation for a measurement calibration. It must be done *before* 28, 29, 30 or 31 are performed.

28 **Ver Dev 1.** This recalls verification limits from disk for verification device #1 in all applicable S-parameter measurements. It performs pass/fail limit testing of the current measurement.

29 **Ver Dev 2.** Same as 27 above for device #2.

30 **Ver Dev 3.** Same as 27 above for device #3.

31 **Ver Dev 4.** Same as 27 above for device #4.

32-43 **Cal Coef 1-12.** These tests copy error term data from a measurement calibration array to display memory. A measurement calibration must be complete and correction must be on. Definition of calibration arrays depends on the current calibration type. After execution, memory is automatically displayed. Formatting, markers, and graphics function normally. Refer to the *Error Term* section for details.

Adjustment Tests

The tests without asterisks are used in the *Adjustments* section of this manual except as noted.

44 ***Source Def.** Writes default correction constants for rudimentary source power accuracy. Use this test before running test 47, below.

45 ***Pretune Def.** Writes default correction constants for rudimentary phase lock pretuning accuracy. Use this test before running test 48, below.

46 **ABUS Cor.** Measures three fixed voltages on the ABUS, and generates new correction constants for ABUS amplitude accuracy in both high resolution and low resolution modes. Use this test before running test 48, below.

47 **Source Cor.** Measures source output power accuracy, flatness, and linearity against an external power meter via HP-IB to generate new correction constants. Run tests 44, 45, 46, and 48 first.

48 **Pretune Cor.** Generates source pretune values for proper phase-locked loop operation. Run tests 44, 45, and 46 first.

49 **Foc/Int Cor.** Stores the current values of the focus and intensity adjustments (under *[DISPLAY]*) for recall at power-on. Only intensity values are stored in HP 8753C and 8702B.

50 **Disp 2 Ex.** Not used in *Adjustments*. Writes the "secondary test pattern" to the display for display adjustments. Press **[PRESET]** to exit this adjustment.

51 **IF Step Cor.** Measures the gain of the IF amplifiers (A and B only) located on the A10 digital IF, to determine the correction constants for absolute amplitude accuracy. It provides smooth dynamic accuracy and absolute amplitude accuracy in the −30 dBm input power region.

52 **ADC Ofs Cor.** This measures the A10 Digital IF ADC linearity characteristics, using an internal ramp generator, and stores values for the optimal operating region. During measurement, IF signals are centered in the optimal region to improve low-level dynamic accuracy.

53 **Sampler Cor.** Measures the absolute amplitude response of the R sampler against an external power meter via HP-IB, then compares A and B, magnitude and phase, against R. It improves the R input accuracy and A/B/R tracking.

54 **Cav Osc Cor.** Calculates the frequency of the cavity oscillator and the instrument temperature for effective spur avoidance.

55 **Serial Cor.** This stores the serial number (input by the user in the Display Title menu) in EEPROM. This routine will not overwrite an existing serial number.

56 **Option Cor.** This stores the option keyword (required for option 002, 006, 010 or any combination).

57 ***Cal Kit Def.** This loads the default calibration kit definitions (device model coefficients) into EEPROM.

Display Tests

These tests do *not* return a PASS/FAIL condition. All six amber front panel LEDs will turn off if the test passes. The display will be blank; press **[PRESET]** to exit the test. If any of the six LEDs remain on, the test has failed.

58 **Disp/cpu com.** This test checks to confirm that the CPU can communicate with the A19 GSP board. The CPU tries to write all zeros, all ones, and then a walking 1 pattern to the GSP and read them back. If the test fails, the CPU will repeat the walking 1 pattern until **[PRESET]** is pressed.

59 **DRAM cell.** This tests the DRAM on A19 by writing a test pattern to the DRAM and then verifying that it can be read back.

60 **Main VRAM.** This tests the VRAM by writing all zeros to one location in each bank and then writing all ones to one location in each bank. Finally a walking one pattern is written to one location in each bank.

61 **VRAM bank.** The GSP tests all the cells in each of the 4 VRAM banks.

62 **VRAM/video.** This test verifies that the GSP is able to successfully perform both write and read shift register transfers. It also checks the video signals LHSYNC, LVSYNC, and LBLANK to verify that they are active and toggling.

63 **RGB outputs.** This test confirms that the analog video signals are correct and it verifies their functionality.

64 **Inten DAC.** This test verifies that the intensity DAC can be set both low and high.

Test Patterns

Test patterns are used in the factory for display adjustments, diagnostics, and troubleshooting, but they are not used for field service. Test patterns are executed by entering the test number (65 through 79), then pressing ***[EXECUTE TEST] [CONTINUE]***. The test pattern will be displayed and the softkey labels blanked. To exit the test pattern and return the softkey labels, press softkey 8 (on the bottom). The following is a description of the test patterns.

65 **Test pat 1.** All White. This pattern is used to verify the light output of the A18 display and to check for color purity. In this, and other solid test patterns, an extremely thin full-screen horizontal line will be seen about 1/4 screen height from the bottom. This condition is characteristic of the CRT does not indicate any problem.

66-68 **Test Pat 2-4.** All Red, Green, Blue. These test patterns verify the color purity of the CRT and also the ability to independently control each gun color. If the purity of the displayed test pattern is a problem, it usually indicates that the face of the CRT needs to be de-gaussed (de-magnetized). If purity is bad, cycling the power a few times may cure the problem. If this does not work, a commercially available de-magnetizer must be used.

69 **Test Pat 5.** 16-Step Gray Scale. This pattern is used to verify that the palette chip on the A19 GSP board can produce 16 different amplitudes of color (in this case, gray.) This pattern is also very useful when using an oscilloscope for troubleshooting. The staircase pattern it produces will quickly show missing or stuck data bits.

70 **Test Pat 6.** 3-Step Gray Scale. This pattern consists of the first three gray scale bars of the 16-step gray scale. It is used for adjusting the background level (or 0 step) so that the first bar is not visible, and the second bar is just barely visible.

71 **Test Pat 7.** Convergence Pattern. This pattern is used when measuring the accuracy of the color convergence. It is mainly for use by the factory, since convergence cannot be adjusted in the field.

72-73 **Test Pat 8-9.** Crosshatch and Inverse Crosshatch. These patterns are used by the factory to test color convergence, linearity, alignment, and high voltage regulation. No field adjustments are possible.

74 **Test Pat 10.** H Pattern. This pattern is used to check the focus of the CRT. Under normal conditions, this should never need to be adjusted. However, it is possible to adjust it by accessing the focus control adjustment at the left rear of the display. See *Adjustments*.

75 **Test Pat 11.** Pixel Stretching. This pattern verifies the functionality of the pixel stretching circuit of the A19 GSP board. Under normal conditions, this pattern should appear all white. If a failure occurs in the pixel stretching circuit, the pattern will consist of 16 alternating white and gray vertical stripes. Suspect problems with with the STRETCH line and LFIRSTPIX.

76 **Test Pat 12.** Repeating Gray Scale. The repeating gray scale is used for troubleshooting with an oscilloscope. It is similar to the 16 step gray scale but is repeated 32 times across the screen. Each of the 3 outputs of the video palette will then show 32 ramps (instead of one staircase) between each horizontal sync pulse. This pattern is used to troubleshoot the pixel processing circuit of the A19 GSP board.

77 **Test Pat 13.** Color Rainbow. The color rainbow quickly shows the ability of the A19 GSP board to display 15 colors plus white. The numbers written below each bar indicate the tint number used to produce that bar (0 & 100=pure red, 33=pure green, 67=pure blue).

78 **Test Pat 14.** Character Set. The character set is provided to conveniently show the user all the different types and sizes of characters available. Three sets of characters are drawn in each of the three character sizes. 125 characters of each size are displayed. Characters 0 and 3 cannot be drawn and several others are really control characters (such as carriage return and line feed).

79 **Test Pat 15.** Bandwidth Pattern. This pattern provides a quick visual verification of the bandwidth of the display. It consists of multiple alternating white and black vertical stripes. Each stripe should be clearly visible. A limited bandwidth would smear these lines together. No field adjustment is possible.

SERVICE FEATURE MENUS

The service feature menus are shown in Figure 2 and described in the following paragraphs. The service feature softkeys are ***[SERVICE MODES]***, ***[ANALOG BUS on OFF]***, ***[PEEK/POKE]***, and ***[FIRMWARE REVISION]***.

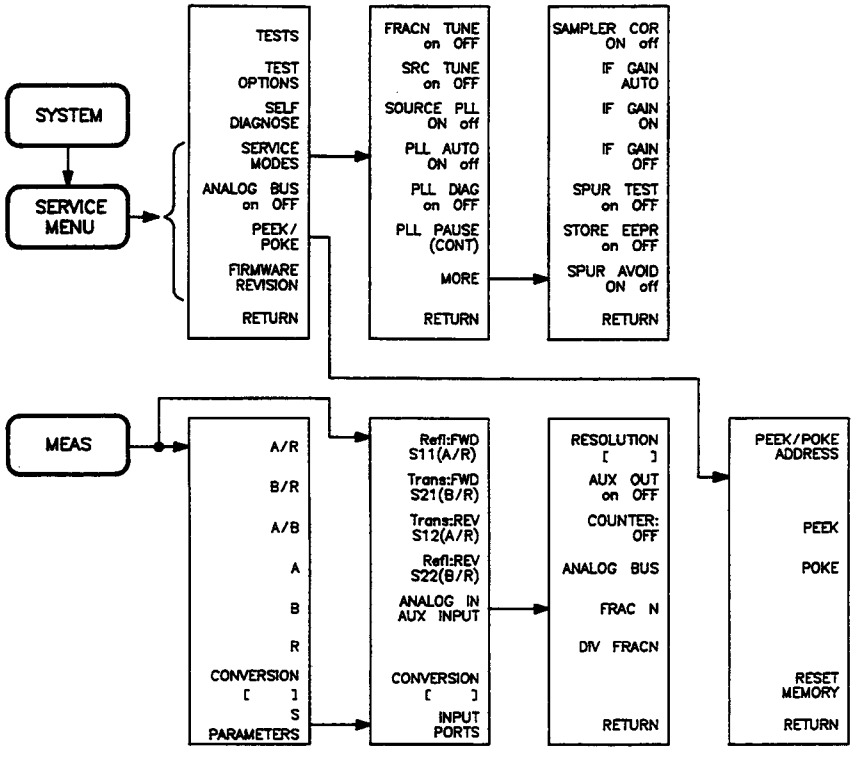


Figure 2. Service Feature Menus
(See Figure 1 for Internal Diagnostics Menus.)

SERVICE MODES MENU

This menu accesses other menus and softkeys that allow you to control and monitor various circuits for troubleshooting. To access the service modes menu, press **[SYSTEM]** ***[SERVICE MENU]*** ***[SERVICE MODES]*** (see Figure 2).

[FRACN TUNE on OFF] (SM1). This mode is useful for testing the A13 and A14 fractional-N circuits. It allows you to directly control and monitor the output frequency of the fractional-N synthesizer (10 MHz to 60 MHz). Set the instrument to CW sweep mode and then set FRACN TUNE ON.

Change frequencies with the front panel keys or knob. The output of the A14 assembly can be checked at A14J1 HI OUT (in high band) or A14J2 LO OUT (in low band) with an oscilloscope, a frequency counter, or a spectrum analyzer. Signal jumps and changes in shape at 20 MHz and 30 MHz when tuning up in frequency, and at 29.2 MHz and 15 MHz when tuning down, are due to switching of the digital divider. This mode can be used with the SRC TUNE mode as described in *Source* troubleshooting.

[SRC TUNE on OFF] (SM2). Use this mode to test the pretune functions of the phase lock and source assemblies. Use the entry controls to set RF OUT to any frequency from 300 KHz to 3 GHz. When in this mode:

- Set analyzer to CW frequency before pressing ***[SRC TUNE ON]***.
- RF OUT is 1 MHz to 6 MHz above indicated (entered) frequency.
- Instrument does not attempt to phase lock.
- Residual FM increases.

[SOURCE PLL ON off] (SM3). With this mode turned OFF, the source stays in the pretune mode and does not attempt to complete the phase lock sequence. Also, all phase lock error messages are disabled. The fractional-N circuits and the receiver operate normally. Therefore, the instrument sweeps, but the source is being driven by the pretune DAC in a stair-stepped fashion.

[PLL AUTO ON off] (SM4). During normal operation (PLL AUTO ON) when the instrument encounters phase lock problems (e.g. "harmonic skip"), it will automatically attempt to determine new pretune values. It will continue to do this until phase lock is achieved. This mode allows you to disable that function so that the phase-locked loop is not continuously trying to recalibrate itself. With PLL AUTO OFF the frequencies and voltages are not changing as they are when they are attempting to phase lock, so troubleshooting the phase-locked loop circuits is more convenient.

[PLL DIAG on OFF] (SM5). The instrument starts a new phase lock sequence at the beginning of each band. This normally occurs very rapidly, making it difficult to troubleshoot phase lock problems. Turning this mode ON slows the process down, allowing you to inspect the steps of the phase lock sequence (pretune, acquire, and track) by pausing at each step. The steps are indicated on the CRT, along with the channel (C1 or C2) and band number (B2 through B11).

This mode can be used with PLL PAUSE to halt the process at any step. It can also be used with the analog bus counter.

[PLL PAUSE]. This mode is used only with PLL DIAG mode. ***[CONT]*** indicates that it will continuously cycle through all steps of the phase lock sequence. ***[PAUSE]*** holds it at any step of interest. This mode is useful for troubleshooting phase-locked loop problems.

[MORE]. This accesses the service modes more menu listed below.

SERVICE MODES MORE MENU

[SAMPLER COR ON off] (SM6). This mode turns the sampler correction off (for diagnosis or adjustment purposes) or on (normal operation).

[IF GAIN AUTO]. This mode is the normal operating condition and works in conjunction with IF GAIN ON and OFF. The A10 assembly includes a switchable attenuator section and an amplifier that amplifies low-level 4 kHz IF signals (for A and B inputs only). This mode allows the A10 IF section to automatically determine if the attenuator should be switched in or out. The switch occurs when the A or B input signal is approximately −30 dBm.

[IF GAIN ON]. This mode locks out the A10 IF attenuator sections, regardless of the amplitude of the A or B IF signal. Be aware that input signal levels above −30 dBm at the sampler input will saturate the ADC and cause measurement errors. Turning this ON switches out both the A and B attenuation circuits; they cannot be switched independently. This mode is useful for checking the A10 IF gain amplifier circuits.

[IF GAIN OFF]. This mode forces the A10 IF attenuators to be switched in, regardless of the amplitude of the A or B IF signal. It is important to note that small input signals will appear noisy, and raise the apparent noise floor of the instrument. Turning this OFF switches both the A and B attenuator circuits; they cannot be switched independently. This mode is useful for checking the A10 IF gain amplifier circuits.

[SPUR TEST on OFF] (SM7). For factory use only.

[STORE EEPR on OFF]. This mode allows you to store the correction constants that reside in non-volatile memory (EEPROM) onto a disk. Correction constants improve instrument performance by compensating for specific operating variations due to hardware limitations (refer to the *Adjustments* section). Having this information on disk is useful as a backup, in case the constants are lost (perhaps due to a CPU board failure). Without a disk backup the correction constants can be regenerated manually, although the procedures are more time consuming.

[SPUR AVOID ON off] (SM8). This mode offsets the frequency of both the A3 YIG oscillator and the A3 cavity oscillator to avoid spurs which can not otherwise be filtered out. ***[SPUR AVOID OFF]*** allows examination of these spurs for service.

ANALOG BUS SOFTKEY

[ANALOG BUS on OFF] (ANAB). This enables and disables the analog bus, described below. Use it with the analog in menu, following.

DESCRIPTION OF THE ANALOG BUS

The analog bus is a single multiplexed line that networks 31 nodes within the instrument. It can be controlled from the front panel, or through HP-IB, to make voltage and frequency measurements just like a voltmeter, oscilloscope, or frequency counter. The next few paragraphs provide general information about the structure and operation of the analog bus. See *Analog Bus Nodes*, below, for a description of each individual node. Refer to the *Overall Block Diagram*, in the *Troubleshooting* section, to see where the nodes are located in the instrument.

The analog bus consists of a source section and a receiver section. The source can be any one of the 31 nodes described in *Analog Bus Nodes* or the A14 fractional-N VCO, or the A14 fractional-N VCO divided down to 100 kHz. The receiver portion can be either the main ADC or the frequency counter. When analog bus traces are displayed, frequency is the x-axis. For a linear x-axis in time, switch to CW time mode (or sweep a single band).

The Main ADC

The main ADC is located on the A10 digital IF assembly and makes voltage measurements in two ranges (see ***[RESOLUTION]***, one of the *Analog In* menu softkeys, below.

The Frequency Counter

The frequency counter is located on the A14 assembly and can count one of three sources: the selected analog bus node, the A14 fractional-N VCO (FRAC N), or the A14 fractional-N VCO divided down to 100 kHz (DIV FRAC N). Its frequency range is 100 kHz to 16 MHz.

The counts are triggered by the phase lock cycle; one each at pretune, acquire, and track for each bandswitch. (The service mode, SOURCE PLL, must be ON for the counter to be updated at each bandswitch). The counter works in swept modes or in CW mode. It can be used in conjunction with SERVICE MODES for troubleshooting phase lock and source problems.

To read the counter over HP-IB, use the command OUTPCNTR.

Notes

- The display and marker units (U) correspond to volts.
- Nodes 17 (1st IF) and 24 (2nd LO) are unreliable above 1 MHz.
- About 0.750 MHz is a typical counter reading with no AC signal present.
- Anything occurring during bandswitches is not visible.
- Fast-moving waveforms may be sensitive to sweep time.
- The analog bus input impedance is about 50K ohms.
- Waveforms up to approximately 200 Hz can be reproduced.

ANALOG IN MENU

Use this menu to select and monitor voltage and frequency nodes with the analog bus and internal counter as explained below.

Press **[SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** to turn on the analog bus and access the Analog In menu.

[RESOLUTION [LOW]]. This toggles between low and high **RESOLUTION**.

Resolution	Maximum Signal	Minimum Signal
LOW	+0.5V	−0.5V
HIGH	+10V	−10V

[AUX OUT on OFF]. This allows you to monitor the analog bus nodes (except nodes 1, 2, 3, 4, 9, 10, 12) with external equipment (oscilloscope, voltmeter, etc.). To do this, connect the equipment to the AUX INPUT BNC connector on the rear panel, and press ***[AUX OUT]***.

CAUTION

NEVER input any signal to the AUX INPUT rear panel connector with this function turned ON. Doing so can cause damage to the instrument.

[COUNTER: OFF]. This switches the internal counter off and removes the counter display from the CRT. The counter can be turned on with one of the next three keys. (Note: Using the counter slows the sweep.) The counter bandwidth is 16 MHz unless otherwise noted for a specific node.

NOTE: OUTPCNTR is the HP-IB command to output the counter's frequency data.

[ANALOG BUS]. This switches the counter to count the analog bus.

[FRAC N]. This switches the counter to count the A14 fractional-N VCO frequency at the node shown on the *Overall Block Diagram*.

[DIV FRAC N]. This switches the counter to count the A14 fractional-N VCO frequency after it has been divided down to 100 kHz for phase locking the VCO.

ANALOG BUS NODES

The following paragraphs describe the 31 analog bus nodes. They are listed in numerical order and are grouped by assembly. Refer to the *Overall Block Diagram* for node locations.

To look at most of the analog bus nodes, the instrument must be phase locked: connect RF OUT through 26 dB of loss to input R (test sets have 19 dB of loss).

A3 Source

To observe six of the eight A3 analog bus nodes (not node 5 or 8), perform step A3, below. Then follow the node specific instructions.

Step A3. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[MEAS]** ***[S–PARAMETERS] [ANALOG IN]*** **[FORMAT]** ***[MORE] [REAL]*** **[MENU]** ***[CW FREQ]*** **[3] [G/n]** ***[SWEEP TYPE MENU] [POWER SWEEP]*** **[START] [–] [1] [0] [x1] [STOP] [2] [5] [x1]** to set up a power sweep on the analog bus.

1 **LM In** (level modulator input detector, see "Source Note", next page)

Perform step A3, above, to set up a power sweep on the analog bus. Then press **[MEAS]** ***[S–PARAMETERS] [ANALOG IN]*** **[1] [x1] [SCALE REF]** ***[AUTO SCALE]***.

Node 1 detects the RF power from the cavity oscillator into the level modulator. Flat line segments indicate ALC saturation and should not occur between −5 dBm and +20 dBm. A flat line at about 0 V indicates the cavity oscillator is not outputting any power.

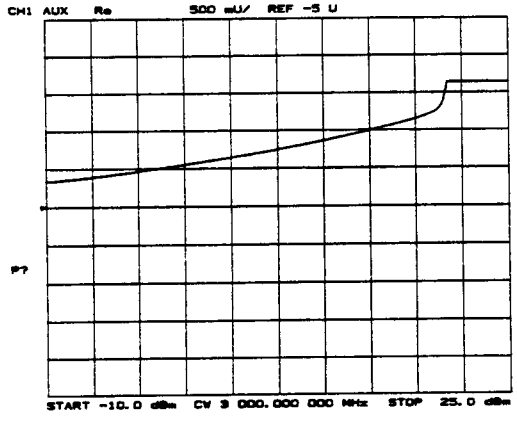


Figure 3. Analog Bus Node 1]

2 **LM Out** (level modulator output detector, see "Source Note", below)

Perform step A3, above, to set up a power sweep on the analog bus. Then press **[MEAS]** ***[[S–PARAMETERS] [ANALOG IN]*** **[2] [x1] [SCALE REF]** ***[AUTO SCALE]***.

Node 2 detects the RF power out of the level modulator. Flat line segments indicate ALC saturation and should not occur between −5 dBm and +20 dBm. In figure 4, the flat part is in the last (right side) division. A flat line at about 0 V indicates the cavity oscillator is not outputting any power.

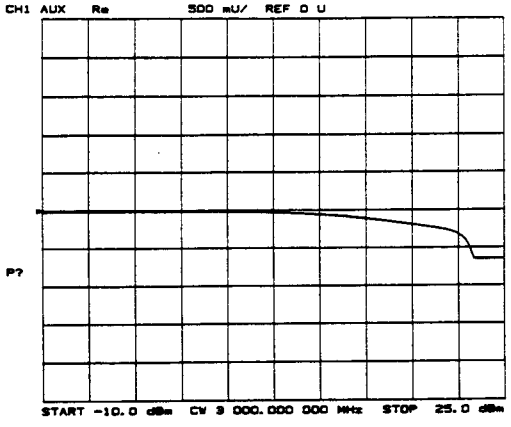


Figure 4. Analog Bus Node 2

3 **Amp In** (amplifier input detector, see "Source Note", below)

Perform step A3, above, to set up a power sweep on the analog bus. Then press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN]*** **[3] [x1] [SCALE REF]** ***[AUTO SCALE]***.

Node 3 detects the power out of the mixer and into the amplifier. Typically the trace is flat at 0V up to about 20 dBm, the response limit of the analog bus detector.

Source Note: analog bus nodes 1, 2, and 3 are non-functional on instruments with serial prefix 3310 or with sources that should measure between 380mV and 485mV at A3Id− to A3Id+. To identify source, inspect it for label.

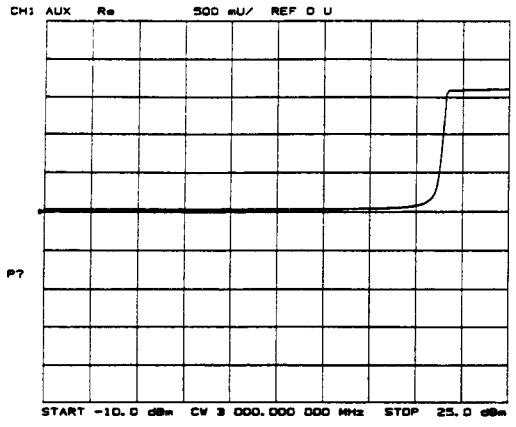


Figure 5. Analog Bus Node 3

4 Det (detects RF OUT power level)

Perform step A3, above, to set up a power sweep on the analog bus. Then press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN]*** **[4] [x1] [SCALE REF]** ***[AUTO SCALE]***.

Node 4 detects power that is coupled and detected from the RF OUT arm to the ALC loop. Note that the voltage exponentially follows the power level inversely. Flat segments indicate ALC saturation and should not occur between −5 dBm and +20 dBm.

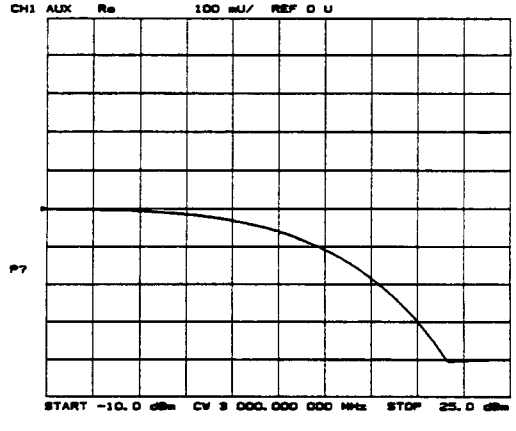


Figure 6. Analog Bus Node 4

5 Temp (temperature sensor)

This node registers the temperature of the cavity oscillator which must be known for effective spur avoidance. The sensitivity is 10 mV per degree Kelvin. The oscillator changes frequency slightly as its temperature changes. This sensor indicates the temperature so that the frequency can be predicted.

6 Integ (ALC leveling integrator output)

Perform step A3, above, to set up a power sweep on the analog bus. Then press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN]*** **[6] [x1] [SCALE REF]** ***[AUTO SCALE]***.

Node 6 displays the output of the summing circuit in the ALC loop. Absolute voltage level variations are normal. Flat segments indicate ALC saturation and should not occur between −5 dBm and +20 dBm.

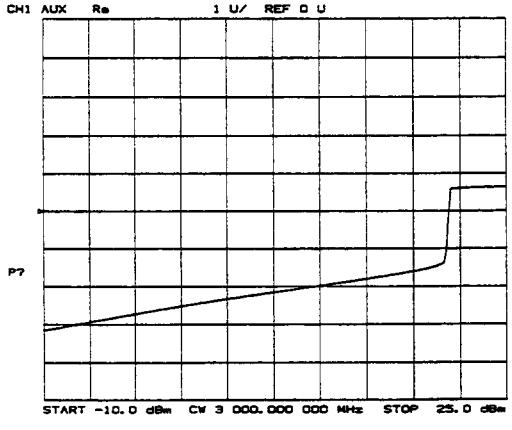


Figure 7. Analog Bus Node 6

7 Log (log amplifier output detector)

Perform step A3, above, to set up a power sweep on the analog bus. Then press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN]*** **[7] [x1] [SCALE REF]** ***[AUTO SCALE]***.

Node 7 displays the output of a logger circuit in the ALC loop. The trace should be a linear ramp. Absolute voltage level variations are normal. Flat segments indicate ALC saturation and should not occur between −5 dBm and +20 dBm.

The proper waveform at node 7 indicates that the circuits in the A3 source ALC loop are normal and the source is leveled.

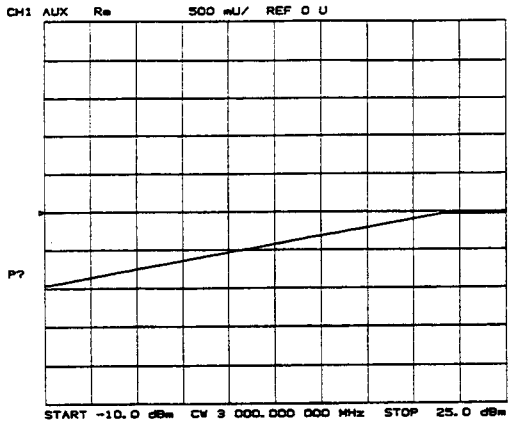


Figure 8. Analog Bus Node 7

8 **A3 Gnd** (ground)

A10 Digital IF

To observe the A10 analog bus nodes perform step A10, below. Then follow the node-specific instructions.

Step A10. Press **[PRESET] [MEAS]** ***[S-PARAMETERS] [ANALOG IN]*** **[MKR] [SYSTEM]** ***[SERVICE MENU] [ANALOG BUS ON]*** **[FORMAT]** ***[MORE] [REAL]*** to use the analog bus.

9 **+0.37V** (+0.37V reference)

Perform step A10, above, and then press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN] RESOLUTION HIGH]*** **[9] [x1]** and check for a flat line at approximately +0.37V. This is used as the voltage reference in the *Analog Bus Correction Constants* adjustment. The voltage level should be the same in high and low resolution; the absolute level is not critical.

10 **+2.50V** (+2.50V reference)

Perform step A10, above, and then press **[MEAS]** ***[S-PARAMETERS] [ANALOG IN] [RESOLUTION LOW]*** **[1] [0] [x1] [SCALE REF] [1] [x1]** and check for a flat line at approximately +2.5V. This voltage is used in the *Analog Bus Correction Constants* adjustment as a reference for calibrating the analog bus low resolution circuitry.

11 Aux Input (rear panel input)

Perform step A10, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [1] [x1]**. This selects the rear panel AUX INPUT to drive the analog bus for making voltage and frequency measurements. It can be used to look at test points within the instrument on the analyzer's CRT (using it as an oscilloscope). Connect the test point of interest to the rear panel AUX INPUT BNC connector.

This feature can be useful if an oscilloscope is not available. Also, it can be used for testing voltage-controlled devices by connecting the driving voltage of the DUT to the AUX IN connector. Look at the driving voltage on one display channel while displaying the DUT S-parameter response on the other display channel.

With ***[AUX OUT]*** turned ON, you can examine the analyzer's analog bus nodes with external equipment (see ***[AUX OUT on OFF]*** under the *Analog Bus Menu* heading). See *HP-IB Service Mnemonic Definitions* for HP-IB considerations.

12 A10 Gnd (ground reference)

This node is used in the *Analog Bus Correction Constants* adjustment as a reference for calibrating the analog bus low and high resolution circuitry.

A11 Phase Lock

To observe the A11 analog bus nodes perform step A11, below. Then follow the node-specific instructions.

Step A11. Press **[PRESET] [MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[MKR] [SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** **[FORMAT]** ***[MORE]*** ***[REAL]*** to use the analog bus.

13 VCO Tune 2 (not used)

14 Vbb Ref (ECL reference voltage level)

Perform step A11, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [4] [x1] [SCALE REF] [.] [3] [x1]** ***[REFERENCE VALUE]*** **[-] [1] [.] [2] [9] [x1]** to observe analog bus node 14. The trace should be within 0.3V (one division) of the reference value. Vbb Ref is used to compensate for ECL voltage drift.

15 Pretune (open-loop source pretune voltage)

Perform step A11, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [5] [x1] [SCALE REF]** ***[AUTOSCALE]***. This node displays the source pretune signal and should look like a stair-stepped ramp. Each step corresponds to the start of a band. Disregard the error message "Caution: No phase lock: Check R input level."

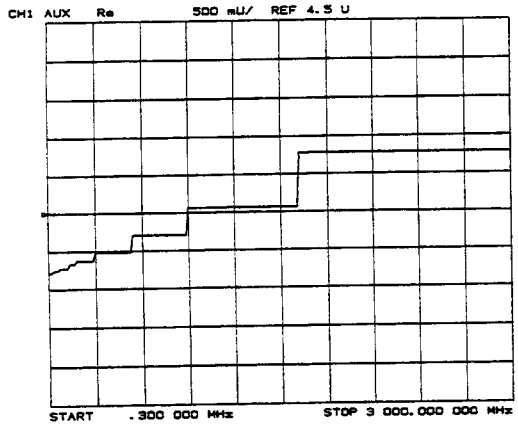


Figure 9. Analog Bus Node 15

16 1V/GHz (source oscillator tuning voltage)

Perform step A11, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [6] [x1] [SCALE REF]** ***[AUTOSCALE]***. This node displays the tuning voltage ramp used to tune the source oscillator. You should see a voltage ramp like the one shown in Figure 10. If this waveform is correct, you can be confident that the A11 phase lock assembly, the A3 source assembly, the A13/A14 fractional-N assemblies, and the A7 pulse generator are working properly and the instrument is phase locked. If you see anything else, refer to the *Source* troubleshooting section.

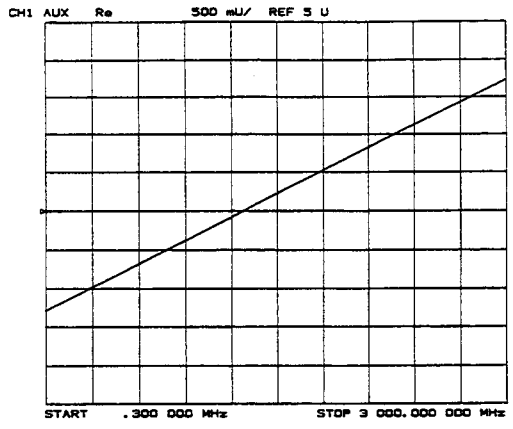


Figure 10. Analog Bus Node 16

17 IF (IF used for phase lock)

Perform step A11, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [7] [x1]** ***[COUNTER: ANALOG BUS]*** **[MENU]** ***[CW FREQ]***. Vary the frequency and compare the results to the table below.

Entered Frequency	Counter Reading
0.3 to 15.999 MHz	same as entered
16 MHz to 3 GHz	1 MHz

This node displays the IF frequency (see figure 11) as it enters the A11 phase lock assembly via the A7 ALC assembly. This signal comes from the R sampler output and is used to phase lock the source.

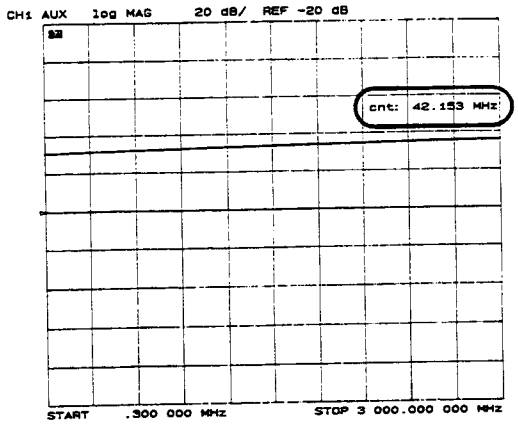


Figure 11. Counter Readout Location

18 IF Det 2N (IF on A11 phase lock after 3 MHz filter)

Perform step A11, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [8] [x1] [STOP] [2] [0] [M/u] [SCALE REF]** ***[AUTOSCALE]***.

This node detects the IF within the low pass filter/limiter. The filter is used during the track and sweep sequences but never in band 1 (3.3 to 16 MHz). The low level (about −1.7V) means IF is in the passband of the filter. This node can be used with the FRAC N TUNE and SRC TUNE service modes.

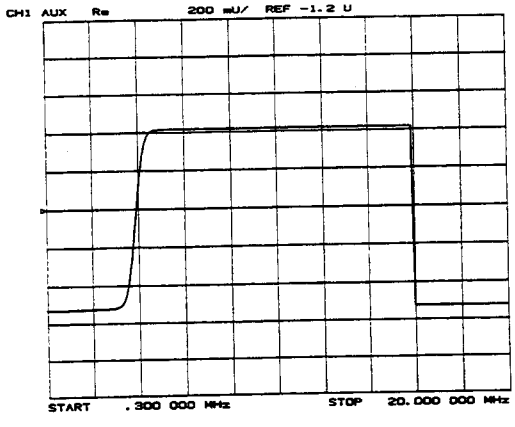


Figure 12. Analog Bus Node 18

19 IF Det 2W (IF after 16 MHz filter)

Perform step A11, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[1] [9] [x1] [MENU] [STOP] [2] [0] [x1] [SCALE REF] [.] [2] [x1]** ***[REFERENCE VALUE]*** **[-] [1] [.] [2] [x1]**. This node detects IF after the 16 MHz filter/limiter. The filter is used during pretune and acquire, but not in band 1. Normal state is a flat line at about −1.7V.

20 IF Det 1 (IF after 30 MHz filter)

Perform step A11, above and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [0] [x1] [SCALE REF] [1] [x1]**. The trace should be a flat line across the entire frequency band at least 0.5 V greater than Vbb (node 14). The proper trace indicates the presence of IF after the first 30 MHz filter/limiter.

A12 Reference

To observe the A12 analog bus nodes perform step A12, below. Then follow the node-specific instructions.

Step A12. Press **[PRESET] [MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[MKR] [SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** **[FORMAT]** ***[MORE]*** ***[REAL]*** to use the analog bus.

21 100 kHz (100 kHz reference frequency)

Perform step A12, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [1] [x1]** ***[COUNTER: ANALOG BUS]***. This node counts the A12 100 kHz reference signal that is used on A13 (the fractional-N analog assembly) as a reference frequency for the phase detector.

22 A12 Gnd 1 (ground)

23 VCO Tune (A12 VCO tuning voltage)

Perform Step A12, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [3] [x1] [STOP] [2] [0] [M/u] [MKR FCTN] [SCALE REF] [.] [1] [x1]**. The trace should show a voltage step as shown in Figure 13. If not, refer to the *High/Low Band Transition Adjustment*.

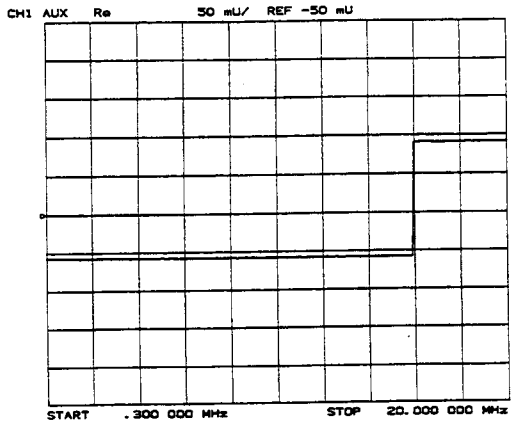


Figure 13. Analog Bus Node 23

24 2nd LO

Perform step A12, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [4] [x1]** ***[COUNTER: ANALOG BUS]*** **[MENU]** ***[CW FREQ]***. This node counts the 2nd LO used by the sampler/mixer assemblies to produce the 2nd IF of 4 kHz. As you vary the frequency, the counter reading should change to values very close to those indicated below:

Frequency Entered	Counter Reading
0.3 to 1 MHz	frequency entered +4 kHz
1 to 16 MHz	not accurate
16 to 3,000 MHz	996 kHz

25 PL Ref (phase lock reference)

Perform step A12, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [5] [x1]** ***[COUNTER: ANALOG BUS]*** **[MENU]** ***[CW FREQ]***. This node counts the reference signal used by the phase comparator circuit on the A11 phase lock assembly. As you vary the frequency, the counter reading should change as indicated below:

Frequency Entered	Counter Reading
0.3 to 1 MHz	frequency entered
1 to 16 MHz	not accurate
16 to 3,000 MHz	1 MHz

26 **Ext Ref** (rear panel external reference input)

Perform step A12, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [6] [x1]**. The voltage level of this node indicates whether an external reference timebase is being used:

- No external reference: about −0.9V
- With external reference: about −0.6V.

27 **VCXO Tune** (40 MHz VCXO tuning voltage)

Perform step A12, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [7] [x1] [MKR FCTN]** ***[MARKER→REFERENCE]***. This node displays the voltage used to fine tune the A12 reference VCXO to 40 MHz. You should see a flat line at some voltage level (the actual voltage level varies from instrument to instrument). Anything other than a flat line indicates that the VCXO is tuning to different frequencies. Refer to the *Frequency Accuracy Adjustment*.

28 **A12 Gnd** (Ground reference)

A14 Fractional-N (Digital)

To observe the A14 analog bus nodes perform step A14, below. Then follow the node-specific instructions.

Step A14. Press **[PRESET] [MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[SYSTEM]** ***[SERVICE MENU]*** ***[ANALOG BUS ON]*** **[FORMAT]** ***[MORE]*** ***[REAL]*** to use the analog bus.

29 **FN VCO Tun** (A14 FN VCO tuning voltage)

Perform step A14, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[2] [9] [x1] [SCALE REF]** ***[AUTOSCALE]*** to observe the A14 FN VCO tuning voltage. If the A13 and A14 assemblies are functioning properly and the VCO is phase locked, the trace should look like Figure 14. Any other waveform indicates that the FN VCO is not phase locked. The vertical lines in the trace indicate the band crossings. (The counter can also be enabled to count the VCO frequency in CW mode.)

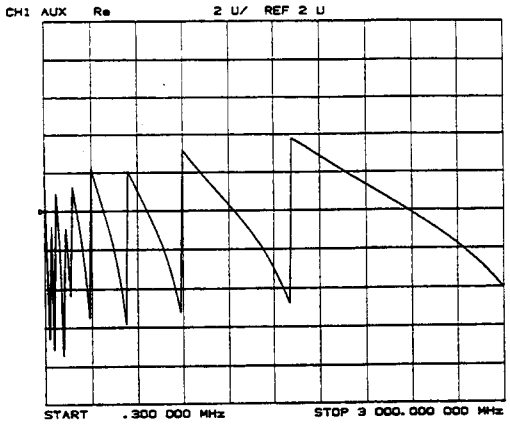


Figure 14. Analog Bus Node 29

30 FN VCO Det (A14 VCO detector)

Perform step A14, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[3] [0] [x1]** ***[RESOLUTION HIGH]*** **[SCALE REF] [5] [0] [k/m]** to see whether the FN VCO is oscillating. The trace should resemble Figure 15.

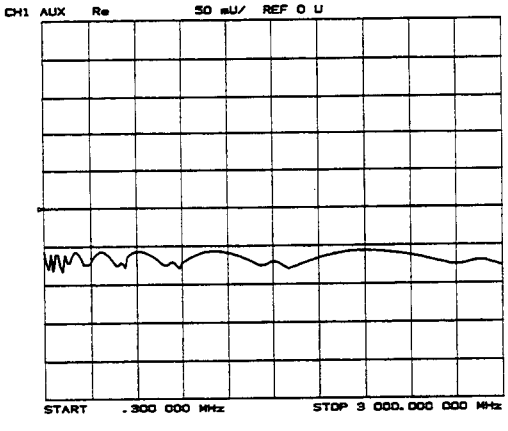


Figure 15. Analog Bus Node 30

31 Count Gate (analog bus counter gate)

Perform step A14, above, and then press **[MEAS]** ***[S-PARAMETERS]*** ***[ANALOG IN]*** **[3] [1] [x1] [SCALE REF] [2] [x1]** to see the analog bus counter gate signal. You should see a flat line at +5V. The counter gate activity occurs during bandswitches, and therefore is not visible on the analog bus. To view the bandswitch activity, look at this node on an oscilloscope, using ***[AUX OUT ON]*** (refer to ***[AUX OUT on OFF]*** under the *Analog Bus Menu* heading.

PEEK/POKE MENU

The ***[PEEK/POKE]*** softkey displays a menu that allows you to access different memory locations to view or change the contents. Access the menu by pressing **[SYSTEM]** ***[SERVICE MENU]*** ***[PEEK/POKE]*** as shown in Figure 2, Service Features Menu. The keys are described below.

CAUTION: PEEK/POKE capability is intended for service use only.

[PEEK/POKE ADDRESS] (PEEL[D]). This softkey accesses any memory address and displays it in the active entry area of the CRT. Use the RPG, entry keys, or step keys to enter the memory address of interest.

[PEEK] (PEEK). This softkey displays the data at the memory address accessed by pressing ***[PEEK/POKE ADDRESS]***.

[POKE] (POKE[D]). This softkey allows you to change the data at the memory address accessed by the ***[PEEK/POKE ADDRESS]*** softkey. Use the RPG, entry keys, or step keys to change the data. The A9CC jumper must be in the "alter" position in order to poke.

[RESET MEMORY]. This softkey allows you to reset or clear the memory where instrument states are stored. To do this, press ***[RESET MEMORY]*** **[PRESET]**.

FIRMWARE REVISION SOFTKEY

Press ***[FIRMWARE REVISION]*** (following **[SYSTEM]** ***[SERVICE MENU]***, see Figure 2) to display the current firmware revision information. The number and implementation date appear in the active entry area of the CRT as shown in Figure 16 below. The installed options are also displayed on the analyzer, except on the HP 8753A. Another way to display the firmware revision information is to cycle power.

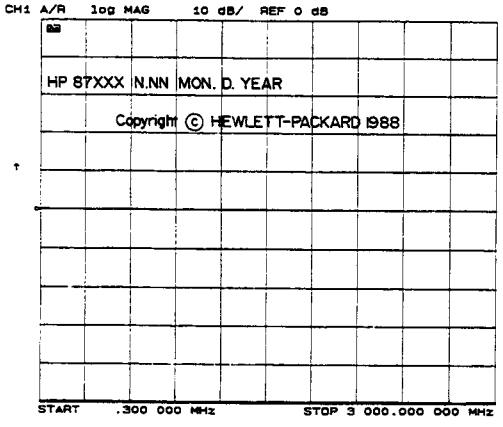


Figure 16. Location of Firmware Revision Information on CRT

HP-IB SERVICE MNEMONIC DEFINITIONS

All service routine keystrokes have equivalent remote HP-IB commands. Most of the service mnemonics have been documented previously with the corresponding keystroke. A few unique softkeys are documented here.

Undocumented softkeys must be accessed remotely by invoking the System menu (MENUSYST) and using the analyzer mnemonic (SOFTn), where "n" represents the softkey number. Softkeys are numbered 1 to 8 from top to bottom.

An HP-IB overview is provided in the *Reference*. HP-IB programming information is also provided in the *HP-IB Programming Guide* and the *HP-IB Quick Reference*.

Invoking Tests Remotely

Many tests require operator response to displayed prompts. These prompts can be anticipated and the appropriate response sent remotely, over the bus, to the analzyer.

- Any time a service routine prompts the user and waits for a response, or when the test finishes, bit 1 of the Event Status Register B is set (bit 1 =service routine waiting). Reading this register resets the bit.

  Initiate the test and either wait in a loop for the "service routine waiting" bit to be set, or enable the bit to interrupt (ESNB[D]). See *Status Reporting* in the *Programming Guide.*

- If the "service routine waiting" bit is set because of a service routine prompt, respond to the prompt with a TESRn command (see *Tests Menu*, at the beginning of this section).

Symbol Conventions

[ ]	An optional operand
D	A numerical operand
< >	A necessary appendage
|	An either/or choice in appendages.

Analog Bus Codes

ANAI[D] Measures and displays the analog input. The preset state input to the analog bus is the rear panel AUX IN. The other 30 nodes may be selected with [D] only if the ABUS is enabled (ANABon).

OUTPCNTR Outputs the counter's frequency data.

OUTPERRO Reads any prompt message sent to the error queue by a service routine.

OUTPTESS Outputs the integer status of the test most recently executed. Status codes are those listed under TST?.

TST? Executes the power-on self test (internal test 1) and outputs an integer test status. Status codes are as follows:

0 =pass
1 =fail
2 =in progress
3 =not available
4 =not done
5 =done

ROM/RAM TESTS

These tests, internal tests 2 through 4, are normally run at preset and power-on (see NORMAL, below). However a jumper on the A9 CPU assembly, illustrated on the *Adjustments* tab, can be set in one of five positions with the following results:

Jumper Name	Position No.	Result
ALTER	1	With the jumper in this right (or top) position, correction constants can be altered, written over in EEPROM. This is used only for correction constant adjustments. Internal tests 2 through 4 are not performed.
CMOS	2	This **destructive** version of the CMOS RAM test (internal test 3) continuously writes over information stored there.
DRAM	3	This **destructive** version of the main DRAM test (internal test 4) continuously writes over information stored there.
SKIP	4	For factory use only.
NORMAL	5	The left (or bottom) position is the normal operation position.

Jumper positions 1 to 5 run right to left (or top to bottom).

For additional information, see *Internal Tests* (near the front of this section) and the *Digital Control* troubleshooting section.

INTRODUCTION

Error terms are factors used for error correction, or accuracy enhancement, in the analyzer when correction is turned on. They are numbers generated and stored in internal arrays during a measurement calibration. They are also known as E-terms or measurement calibration coefficients.

Error terms can also serve a diagnostic purpose. Specific parts of the analyzer and its accessories directly contribute to the magnitude and shape of the error terms. Since we know this correlation and we know what typical error terms look like, we can examine error terms to monitor system performance or to identify faulty components in the system.

Error terms are created by measuring well-defined calibration devices over the frequency range of interest and comparing the measured data with the ideal model for the devices. The differences represent systematic (repeatable) errors of the analyzer system. The resulting calibration coefficients are good representations of the systematic error sources. For details on error correction, refer to the *Measurement Calibration* chapter of the *Reference*.

Use the procedures below to generate and examine error terms. No external controller is required. This information can be useful in two ways:

- **Preventive Maintenance**. A stable, repeatable system should generate repeatable error terms over long time intervals, for example, six months. Make a hardcopy record (print or plot) of the error terms, then periodically compare current error terms with the record. A sudden shift in error terms reflects a sudden shift in systematic errors, and may indicate the need for further troubleshooting. A long-term trend often reflects drift, connector and cable wear, or gradual degradation, indicating the need for further investigation and preventive maintenance. Note that the system may still conform to specifications. The cure is often as simple as cleaning and gaging connectors or inspecting cables.
- **Troubleshooting**. If a subtle failure or mild performance problem is suspected, the magnitude of the error terms should be compared against values generated previously with the same instrument and calibration kit. This comparision will produce the most precise view of the problem.

  However, if previously generated values are not available, compare the current values to the typical values listed in Table 2, *Uncorrected Performance*, and shown graphically on the plots in this section. If the magnitude exceeds its limit, the corresponding system component should be inspected. If the condition causes system verification to fail, the component should be replaced.

Consider the following while troubleshooting:

- All parts of the system, including cables and calibration devices, can contribute to systematic errors and impact the error terms.
- Connectors must be clean, gaged, and within specification for error term analysis to be meaningful.
- Avoid unnecessary bending and flexing of the cables following measurement calibration, to minimize cable instability errors.
- Use good connection techniques during the measurement calibration. The connector interface *must* be repeatable. Refer to the *microwave connector care* information in the operating manual for information on connection techniques and on cleaning and gaging connectors.
- Use error term analysis to troubleshoot minor, subtle performance problems. Refer to the *Troubleshooting* section if a blatant failure or gross measurement error is evident.
- It is often worthwhile to perform the procedure twice (using two distinct measurement calibrations) to establish the degree of repeatability. If the results do not seem repeatable, check all connectors and cables.

MEASUREMENT CALIBRATION PROCEDURE

1. Connect the system components together: analyzer, test set, and a test port cable attached to each test port. Adapt to 7mm connectors at the measurement plane if necessary.
2. Press **[PRESET] [CAL]**. For HP 8702, press ***[DEVICE TYPE] [E/E] [RETURN]***. Then, for all analyzers, press ***[CALIBRATE MENU] [FULL 2-PORT]*** to perform a full 2-port calibration. Follow the prompts; refer to *Measurement Calibration* in the *Reference* if full instructions are needed. (If desired, select a different calibration from Table 1.)
3. Store this calibration into an internal register or on disk.

Table 1. Calibration Coefficient Terms and Tests

Cal Coeff.	Calibration Type				Test Number
	Response	Resp & Isol'n[1]	1-port	2-port[2]	
1	E_R or E_T	E_X (E_D)	E_D	E_{DF}	32
2		E_T (E_R)	E_S	E_{SF}	33
3			E_R	E_{RF}	34
4				E_{XF}	35
5				E_{LF}	36
6				E_{TF}	37
7				E_{DR}	38
8				E_{SR}	39
9				E_{RR}	40
10				E_{XR}	41
11				E_{LR}	42
12				E_{TR}	43

NOTES:

- Meaning of first subscript: D=directivity; S=source match; R=reflection tracking; X=crosstalk; L=load match; T=transmission tracking.
- Meaning of second subscript: F=forward; R=reverse.

1. Resp & Isol'n cal yields: E_X or E_T if a transmission parameter (S_{21}, S_{12}) or E_D or E_R if a reflection parameter (S_{11}, S_{22})
2. One-path, 2-port cal duplicates arrays 1 to 6 in arrays 7 to 12.

ERROR TERM INSPECTION

NOTE: If correction is not on, press **[CAL]** ***[CORRECTION ON]*** now.

Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[3] [2] [x1]** ***[EXECUTE TEST]*** to display the first calibration measurement trace (Table 1 lists the test numbers). The test copies the calibration measurement trace for the selected error term into display memory and displays it.

Use the scale, reference, and marker functions to study the error term trace and determine its magnitude. Compare it to the *Error Term Descriptions* below and to earlier data measured on the system. If system-specific data is not available, refer to the typical uncorrected performance specifications listed in Table 2. To make a hardcopy of a trace, see *Hardcopy Procedure*.

If an error term seems much worse than the typical values, you may want to perform a system verification to make sure that the system still conforms to specifications. If system verification fails, refer to *Troubleshooting*.

Table 2. Uncorrected System Performance

UNCORRECTED PERFORMANCE
The following table shows typical performance without accuracy enhancement. RF cables not used except as noted. Related error terms should be within these values.

	Frequency Range (GHz)	
	0.0003 to 3.0	**3.0 to 6.0**
Directivity	30 dB	25 dB
Source Match	16 dB	14 dB
Load Match	16 dB	14 dB
Reflection Tracking*	±1.5 dB	+0.5 dB, −2.5 dB
Transmission Tracking*	±1.5 dB	+0.5 dB, −2.5 dB
Crosstalk	90 dB	80 dB

*Deviation from nominal trace across the frequency range.

Hardcopy Procedure

To make a hardcopy record of the trace: Connect a printer or plotter and press **[LOCAL]** ***[SYSTEM CONTROLLER]*** **[COPY]** ***[PRINT]*** (or ***[PLOT]***). Title each trace with the title feature or manually so that it can be identified later. Refer to the *Copy* chapter of the *Reference* for more copying information.

ERROR TERM DESCRIPTIONS

Following are descriptions of each error term, its significance, typical results, and guidelines to interpretation. The same description applies to both the forward (F) and reverse (R) terms. The plots shown with each are typical of a working system following a full 2-port calibration as performed in *Measurement Calibration Procedure*, above.

Directivity (EDF and EDR)

Description. These are the uncorrected forward and reverse directivity error terms of the system. The directivity error of the test port is determined by measuring the S11 and S22 reflection of the calibration kit load. The load has a much better return loss specification than does the uncorrected test port, therefore any power detected from this measurement is assumed to be due to directivity error.

Significant System Components. The load used in the calibration is the most important component. The test port connector and the test set bridge directivity also greatly affect the measured directivity error. Test port cables have a significant effect.

Affected Measurements. The measurements most affected by directivity errors are measurements of low reflection devices; highly reflective device measurements will appear normal.

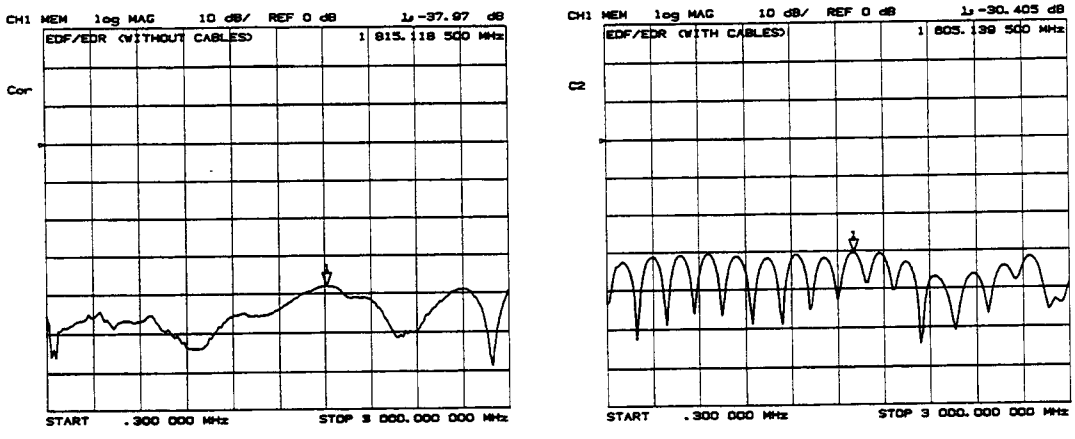

CH1 MEM log MAG 10 dB/ REF 0 dB 1: -37.97 dB
EDF/EDR (WITHOUT CABLES)
1 815.118 500 MHz
Cor
START .300 000 MHz
STOP 3 000.000 000 MHz
CH1 MEM log MAG 10 dB/ REF 0 dB 1: -30.405 dB
EDF/EDR (WITH CABLES)
1 805.139 500 MHz
C2
START .300 000 MHz
STOP 3 000.000 000 MHz

Figure 1. Typical EDF/EDR Without and With Cables

Source Match (ESF and ESR)

Description. These are the forward and reverse uncorrected source match terms of the driven port. They are obtained by measuring the reflection (S11, S22) of an open and then a short connected directly to the ports. Source match is a measure of the match of the test port connector, as well as the match between all components from the source to the test port.

Significant System Components. The open and short calibration devices are important, as are the bridge and test port connectors. The power splitter, bias tees, step attenuator, transfer switch, and test port cables may also contribute to source match errors.

Affected Measurements. The measurements most affected by source match errors are reflection and transmission measurements of highly reflective DUTs.

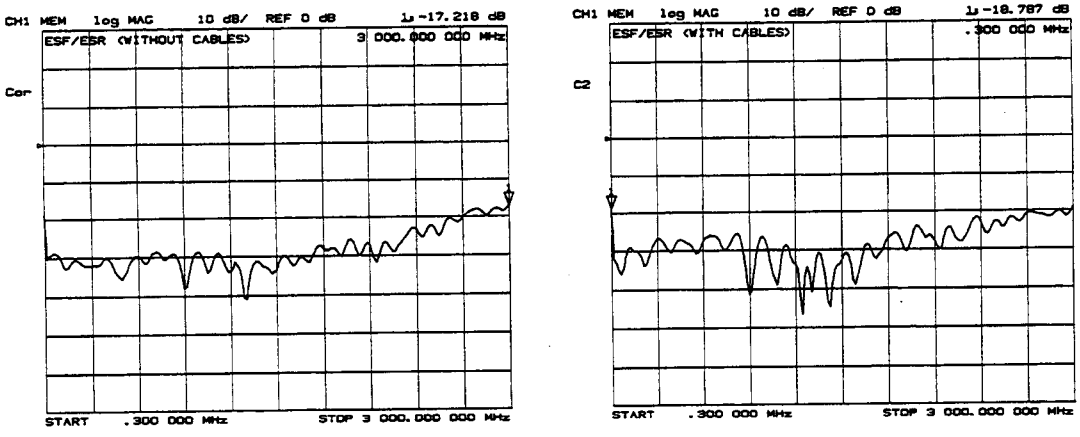

CH1 MEM log MAG 10 dB/ REF 0 dB -17.218 dB
ESF/ESR (WITHOUT CABLES)
3 000.000 000 MHz
Cor
START .300 000 MHz
STOP 3 000.000 000 MHz
CH1 MEM log MAG 10 dB/ REF 0 dB -18.787 dB
ESF/ESR (WITH CABLES)
.300 000 MHz
C2
START .300 000 MHz
STOP 3 000.000 000 MHz

Figure 2. Typical ESF/ESR Without and With Cables

Reflection Tracking (ERF and ERR)

Description. Reflection tracking is the difference between the frequency response of the reference path (R path) and the frequency response of the reflection test path (A or B input path). These error terms are characterized by measuring the reflection (S11, S22) of the open and the short during the measurement calibration.

Significant System Components. The open and short calibration devices have an effect on reflection tracking. But large variations in this error term may indicate a problem in one of the signal paths. Suspect the R signal path if the problem appears in both ERF and ERR. Troubleshoot the A or B input paths first if only one reflection tracking term is affected.

Affected Measurements. All reflection measurements (high or low return loss) are affected by the reflection tracking errors.

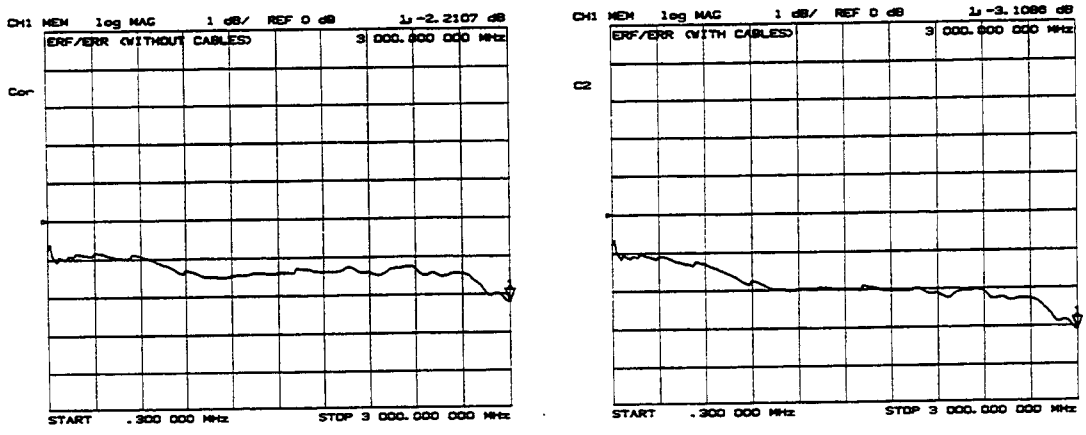

CH1 MEM log MAG 1 dB/ REF 0 dB 1: -2.2107 dB
ERF/ERR (WITHOUT CABLES)
3 000.000 000 MHz
Cor
START .300 000 MHz
STOP 3 000.000 000 MHz
CH1 MEM log MAG 1 dB/ REF 0 dB 1: -3.1086 dB
ERF/ERR (WITH CABLES)
3 000.000 000 MHz
C2
START .300 000 MHz
STOP 3 000.000 000 MHz

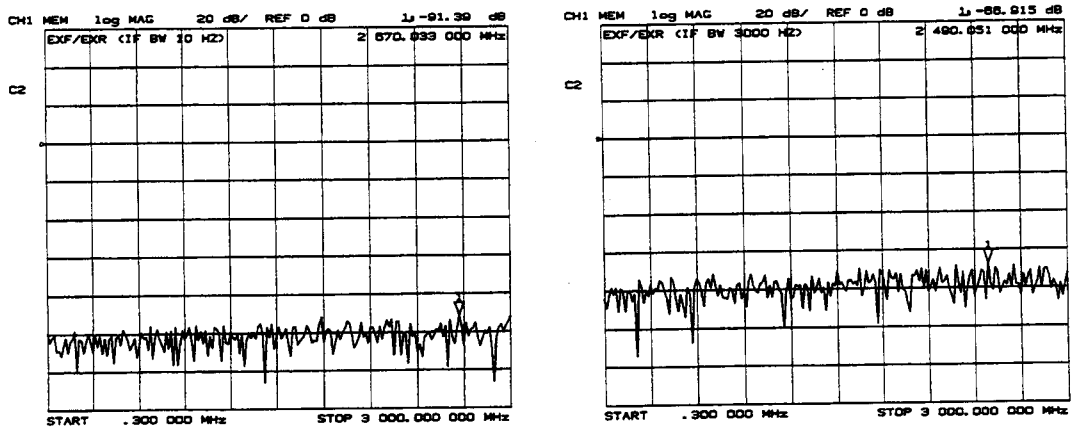
Figure 3. Typical ERF/ERR Without and With Cables

Isolation (Crosstalk, EXF and EXR)

Description. These are the uncorrected forward and reverse isolation error terms that represent leakage between the test ports and the signal paths. The isolation error terms are characterized by measuring transmission (S21, S12) with loads attached to both ports during the measurement calibration. Since these terms are low in magnitude, they are usually noisy (not very repeatable). The error term magnitude changes dramatically with IF bandwidth: a 10 Hz IF bandwidth must be used in order to lower the noise floor beyond the crosstalk specification. Using averaging will also reduce the peak-to-peak noise in this error term.

Significant System Components. Isolation problems are usually due to sampler crosstalk in the analyzer, perhaps due to leakage caused by loose screws or shielding. (Crosstalk in the test set is usually negligible.)

Affected Measurements. Isolation errors affect both reflection and transmission measurements, primarily where the measured signal level is very low. Examples include reflection measurements of a well-matched DUT, and transmission measurements where the insertion loss of the DUT is large.


CH1 MEM log MAG 20 dB/ REF 0 dB 1: -91.39 dB
EXF/EXR (IF BW 10 HZ)
2 870.033 000 MHz
C2
START .300 000 MHz
STOP 3 000.000 000 MHz
CH1 MEM log MAG 20 dB/ REF 0 dB 1: -88.915 dB
EXF/EXR (IF BW 3000 HZ)
2 490.051 000 MHz
C2
START .300 000 MHz
STOP 3 000.000 000 MHz

4(a) *4(b)*

Figure 4. Typical EXF/EXR with 10 Hz Bandwidth and with 3 kHz Bandwidth

Load Match (ELF and ELR)

Description. Load match is a measure of the impedance match of the test port that terminates the output of a 2-port device. Load match error terms are characterized by measuring the S11 and S22 responses of a "thru" configuration during the calibration procedure.

Significant System Components. Large variations in the forward or reverse load match error terms may indicate a bad "thru" cable or a poor connection of the cable to the test port.

Affected Measurements. The measurements most affected by load match errors are all transmission measurements, and reflection measurements of a low insertion loss two-port device, such as an airline.

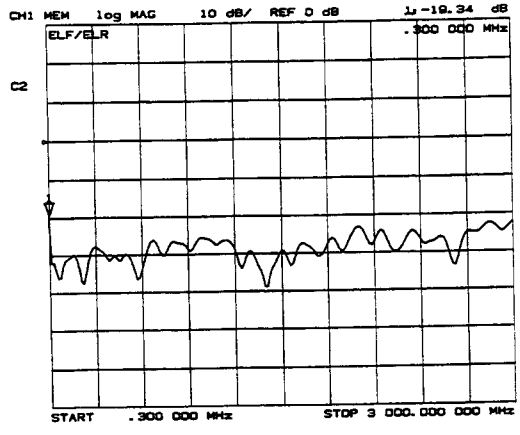


Figure 5. Typical ELF/ELR

Transmission Tracking (ETF and ETR)

Description. Transmission tracking is the difference between the frequency response of the reference path (including R input) and the frequency response of the transmission test path (including A or B input) while measuring transmission. The response of the test port cables is included. These terms are characterized by measuring the transmission (S21, S12) of the "thru" configuration during the measurement calibration.

Significant System Components. Large variations in this error term probably indicate a problem in the reference signal path (if both ETF and ETR are bad) or in the A or B input path. The "thru" cable also has an effect on transmission tracking.

Affected Measurements. All transmission measurements are affected by transmission tracking errors.

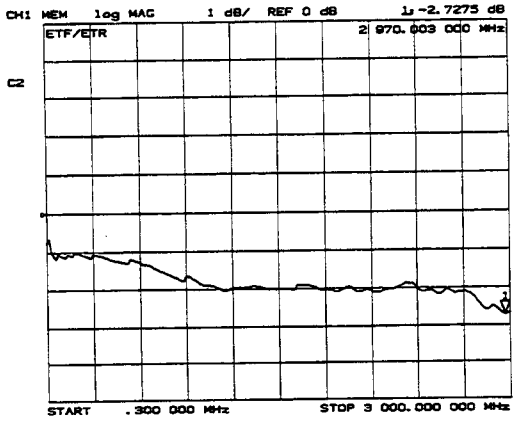


Figure 6. Typical ETF/ETR

INTRODUCTION

Theory of Operation begins with a general description of the operation of an analyzer system, including the test sets. This is followed by more detailed operating theory for the analyzer itself, divided into functional groups.

Each functional group consists of a number of assemblies that combine to perform one of the basic instrument functions. These groups are power supplies, digital control, source, and receiver. The operation of each group is described briefly, to the assembly level only. Detailed component-level circuit theory is not provided here.

Simplified block diagrams illustrate the operation of each functional group. An overall block diagram is provided at the end of the *Troubleshooting* section.

SYSTEM THEORY

A network analyzer system consists of a source, signal separation devices (a test set or power splitter), a receiver, and a display. A lightwave analyzer system includes a lightwave source and receiver. The analyzer integrates a high resolution synthesized RF source and a dual channel three-input receiver for measurement and display of test device characteristics. Figure 1 is a simplified block diagram of the network analyzer system.

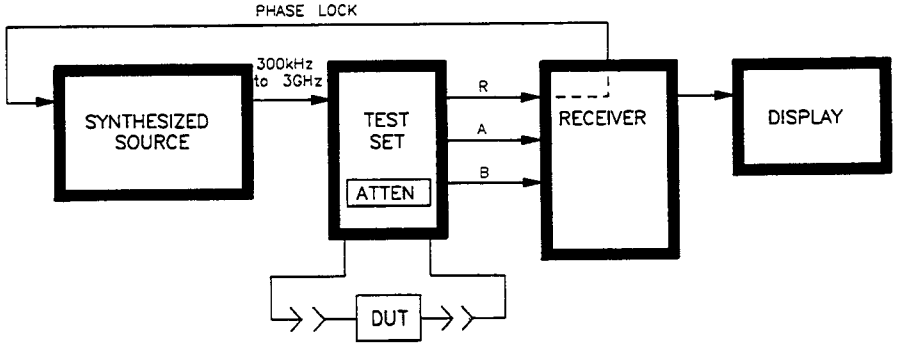


Figure 1. Simplified System Block Diagram

The built-in synthesized source generates a CW (continuous wave) or swept RF signal in the range of 300 kHz to 3.0 GHz. The RF output power is leveled by an internal ALC (automatic leveling control) circuit, to a maximum level of +20 dBm. To achieve phase lock, a portion of the RF signal is routed through the test set or other external coupling to the R input of the receiver, where it is sampled by the phase detection loop and fed back to the source.

The signal separation device in a network analyzer system is an HP 85047A or 85046A/B S-parameter test set, an HP 85044A/B transmission/reflection test set, or an HP 11850C/D or 11667A power splitter. The test sets are described below.

The source RF signal goes through the test set to the device under test. The signal transmitted through the device or reflected from its input is applied to the B and/or A inputs of the receiver and compared with the incident signal at input R.

In a lightwave measurement system the 300 kHz to 3 GHz RF signal provides electrical modulation of the lightwave source. The lightwave source converts the RF to an optical signal that is applied to the DUT. The signal transmitted or reflected from the DUT feeds into the lightwave receiver for demodulation back to RF. The signal is processed by the receiver block of the analyzer.

The receiver contains three identical sampler/mixers for the R, A, and B inputs, which convert the RF input frequency to a 4 kHz IF (intermediate frequency) for signal processing. Sampling retains both magnitude and phase characteristics as the RF signal is converted into the IF. The three input signals are multiplexed into the ADC (analog to digital converter), where they are converted to digital signals.

The raw data is then processed. Details of the data processing signal flow are provided in the *General Information* section of the operating manual. The processed and formatted data is finally routed to the CRT for display, and to HP-IB for remote operation.

The test sets are described briefly here; for more information refer to the test set manuals. A description of the functional groups of the analyzer follows.

Test Sets

The HP 85047A S-parameter test set contains a switched frequency doubler to double the source frequency. A portion of the RF signal is coupled to the analyzer R input for reference. The remaining signal is routed through a 70 dB programmable step attenuator to the directional couplers for reflection and transmission measurements. The couplers allow detection of the signal from 300 kHz to 6 GHz (300 kHz to 3 GHz or 3 MHz to 6 GHz in a single sweep.) These couplers provide low insertion loss between the RF input and the test ports. Two bias tees supply external biasing for active devices. An HP 8753B/C Option 006 is required for use with the HP 85047A test set. Figure 2 (a) shows a simplified block diagram of the HP 85047A.

The HP 85046A/B S-parameter test set contains a power splitter to divert a portion of the incident signal to the R input of the analyzer for reference. The remainder of the incident signal is routed through a switch to one of two directional bridges at the measurement ports. The RF path switch is controlled by the analyzer to enable switching between forward and reverse measurements. A 70 dB step attenuator in the test set, also controlled from the analyzer, adjusts the power level to the DUT without changing the level of the incident power in the reference path. Two bias tees are included, for external biasing of active devices connected to the test ports. Figure 2 (b) shows a simplified block diagram of the HP 85046A/B.

The HP 85044A/B transmission/reflection test set contains a power splitter to divert a portion of the incident signal to the R input of the analyzer. The remainder of the incident signal is routed through a directional bridge to the measurement port. The test set includes a manually controlled 70 dB step attenuator, and a bias tee for external biasing of active devices connected to the test port. A simplified block diagram of the HP 85044A/B is shown in Figure 2 (c).

An HP 11850C/D or 11667A power splitter can be used instead of a test set for transmission measurements only.

In addition to the analyzer, the signal separation device, and the lightwave source and reciver, a system includes cables for interconnections, calibration standards for accuracy enhanced measurements, and a lightwave coupler for optical reflection measurements.

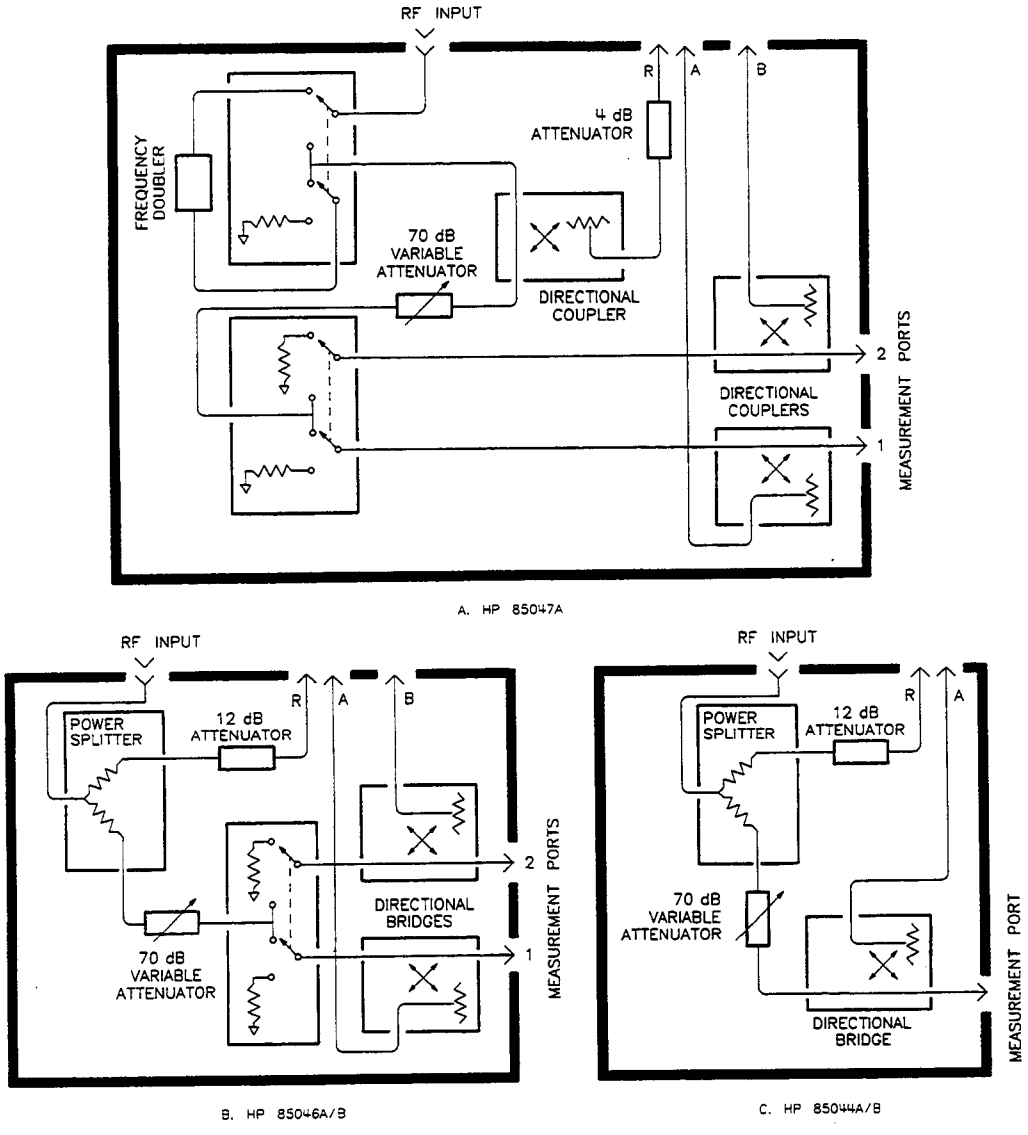


Figure 2. Simplified Block Diagrams of the Test Sets

ANALYZER FUNCTIONAL GROUPS

The operation of the analyzer is most logically described in four functional groups. Each group consists of several major assemblies, and performs a distinct function in the instrument. Some assemblies are related to more than one group, and in fact all the groups are to some extent interrelated and affect each other's performance.

Power Supply. The power supply functional group consists of the A8 post-regulator and the A15 preregulator. It supplies power to the other assemblies in the instrument.

Digital Control. The digital control group consists of the A1 front panel and A2 front panel processor, the A9 CPU, the A16 rear panel, the A18 display and in the HP 8753C and 8702B, the A19 graphics system processor (GSP). The A10 digital IF assembly is also related to this group. These assemblies combine to provide digital control for the analyzer and an HP 85047A or 85046A/B S-parameter test set if used.

Source. The source group consists of the A3 source, A7 pulse generator, A11 phase lock, A12 reference, A13 fractional-N (analog), and A14 fractional-N (digital) assemblies. The A4 sampler is also related. The source supplies a phase-locked RF signal to the device under test.

Receiver. The receiver group consists of the A4/A5/A6 sampler/mixers and the A10 digital IF. The A12 reference assembly and the A9 CPU are also related. The receiver measures and processes input signals for display.

The following pages describe the operation of each of the functional groups.

POWER SUPPLY THEORY

The power supply functional group consists of the A15 preregulator and the A8 post-regulator. These two assemblies comprise a switching power supply that provides regulated DC voltages to power all assemblies in the analyzer. The A15 preregulator is enclosed in a casting at the rear of the instrument behind the display. It is connected to the A8 post-regulator by a wire bus A15W1. Figure 3 is a simplified block diagram of the power supply group.

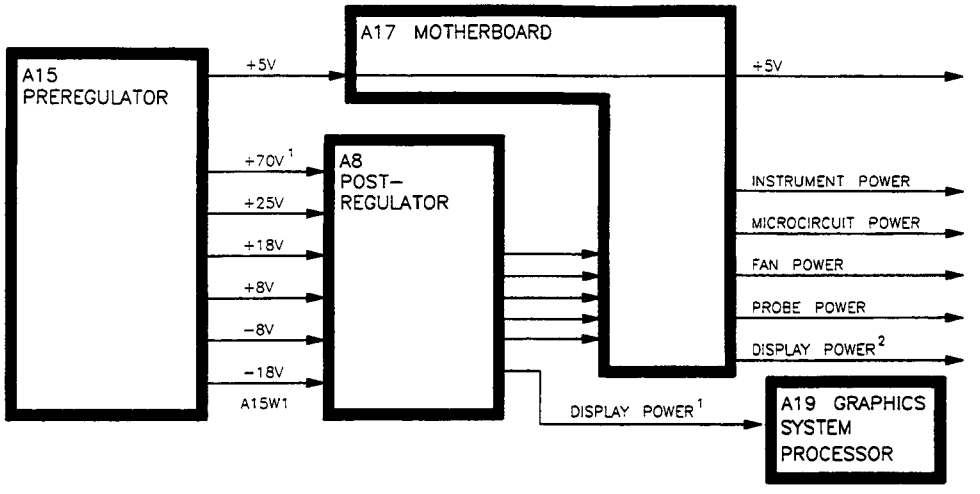


Figure 3. Power Supply Functional Group, Simplified Block Diagram

A15 Preregulator

The A15 preregulator steps down and rectifies the line voltage. It provides a fully regulated +5V digital supply, and several preregulated voltages that go to the A8 post-regulator assembly for additional regulation.

The A15 preregulator assembly includes the line power module, a 60 kHz switching preregulator, and overvoltage protection for the +5V digital supply. It provides LEDs, visible from the rear of the instrument, to indicate circuit status.

Line Power Module. The line power module includes the line power switch, voltage selector switch, and main fuse. The line power switch is activated from the front panel. The voltage selector switch, accessible at the rear panel, adapts the analyzer to local line voltages of approximately 115V or 230V. The main fuse, which protects the input side of the preregulator against drawing too much line current, is also accessible at the rear panel. Refer to the *Installation* section of the *User's Guide* for line voltage tolerances and other power considerations.

Preregulated Voltages. The switching preregulator converts the line voltage to several DC voltages. The regulated +5V digital supply goes directly to the motherboard. The following partially regulated voltages are routed through A15W1 to the A8 post-regulator for final regulation:

+65V* +25V +18V −18V +8V −8V

*HP 8753C and 8702B only.

Regulated +5V Digital Supply. The +5VD supply is regulated by the control loop in the A15 preregulator. It goes directly to the motherboard, and from there to all assemblies requiring a digital supply. A +5V sense line returns from the motherboard to the A15 preregulator. In the HP 8753A/B and 8702A, the +5VCPU line is derived directly from +5VD but a different line takes it through the motherboard and the A8 post-regulator to the A9 CPU assembly, the A1/A2 front panel, and the A18 display. In the HP 8753C and 8702B, the +5V CPU is derived fromt he +5 VD in the A8 post-regulator and goes directly to the A19 graphics system processor.

In order for the preregulator to function, the +5V digital supply must be loaded by one or more assemblies, and the +5V sense line must be working. If not, the other preregulated voltages will not be correct.

Shutdown Indications: the Green LED and Red LED. The green LED is on in normal operation. It is off when line power is not connected, not turned on, or set too low, or if the line fuse has blown.

The red LED, which is off in normal operation, lights to indicate a fault in the +5V supply. This may be an overvoltage, undervoltage, overcurrent, or overtemperature condition. Refer to the troubleshooting procedures for more information.

A8 Post-Regulator

The A8 post-regulator filters and regulates the DC voltages received from the A15 preregulator. It provides fusing and shutdown circuitry for individual voltage supplies. It distributes regulated constant voltages to individual assemblies throughout the instrument. It includes the overtemperature shutdown circuit, the variable fan speed circuit, and the air flow detector. Ten (nine in the HP 8753C and 8702B) green LEDs provide status indications for the individual voltage supplies.

Refer to the wiring list in the *Troubleshooting and Block Diagram* section for a complete listing of the assemblies served by each of the voltages from the A8 post-regulator.

Voltage Indications: the Green LEDs. The ten (or nine) green LEDs along the top edge of the A8 assembly are on in normal operation, to indicate the correct voltage is present in each supply. If they are off or flashing, a problem is indicated. The troubleshooting procedures later in this section detail the steps to trace the cause of the problem.

Shutdown Circuit. The shutdown circuit is triggered by overcurrent, overvoltage, undervoltage, or overtemperature. It protects the instrument by causing the regulated voltage supplies to be shut down. It also sends status messages to the A9 CPU to trigger warning messages on the CRT. The voltages that are not shut down are the +5VD and +5VCPU digital supplies from the preregulator, the fan supplies, the probe power supplies, and the display supplies. The shutdown circuit can be disabled momentarily for troubleshooting purposes by jumpering the SDIS line to ground.

Variable Fan Circuit and Air Flow Detector. The fan power is derived directly from the +18V and −18V supplies from the A15 preregulator. The fan is not fused, so that it will continue to provide airflow and cooling when the instrument is otherwise disabled. If overheating occurs, the main instrument supplies are shut down and the fan runs at full speed. An overtemperature status message is sent to the A9 CPU to initiate a warning message on the CRT. The fan also runs at full speed if the air flow detector senses a low output of air from the fan. (Full speed is normal at initial power on.)

Display Power. The A8 assembly supplies voltages to the display through a wire cable. In the HP 8753A/B and 8702B, these supplies are +5VCPU, +15VDSP, and −15VDSP. In the HP 8753C and 8702B, the A8 supplies +5VCPU and +65V to the A19 GSP, then the +65V is routed to the display. The +15VDSP and −15VDSP supplies are unique to the display and are not used by any other assemblies; they are individually fused and regulated in the post-regulator assembly. They are not connected to the protective shutdown circuitry so that the A18 display assemblies can operate during troubleshooting when other supplies do not work.

Probe Power. The +18V and −18V supplies are post-regulated to +15V and −12.6V to provide a power source at the front panel for an external RF probe, lightwave or milli-meter modules.

DIGITAL CONTROL THEORY

The digital control functional group consists of the following assemblies:

A1 front panel
A2 front panel processor
A9 CPU
A18 display
A16 rear panel
A19 GSP (HP 8753C and 8702B only)

These assemblies combine to provide digital control for the entire analyzer and HP 85047A and 85046A/B S-parameter test set. They provide math processing functions, as well as communications between the analyzer and an external controller and/or periperals. Figure 4 is a simplified block diagram of the digital control functional group.

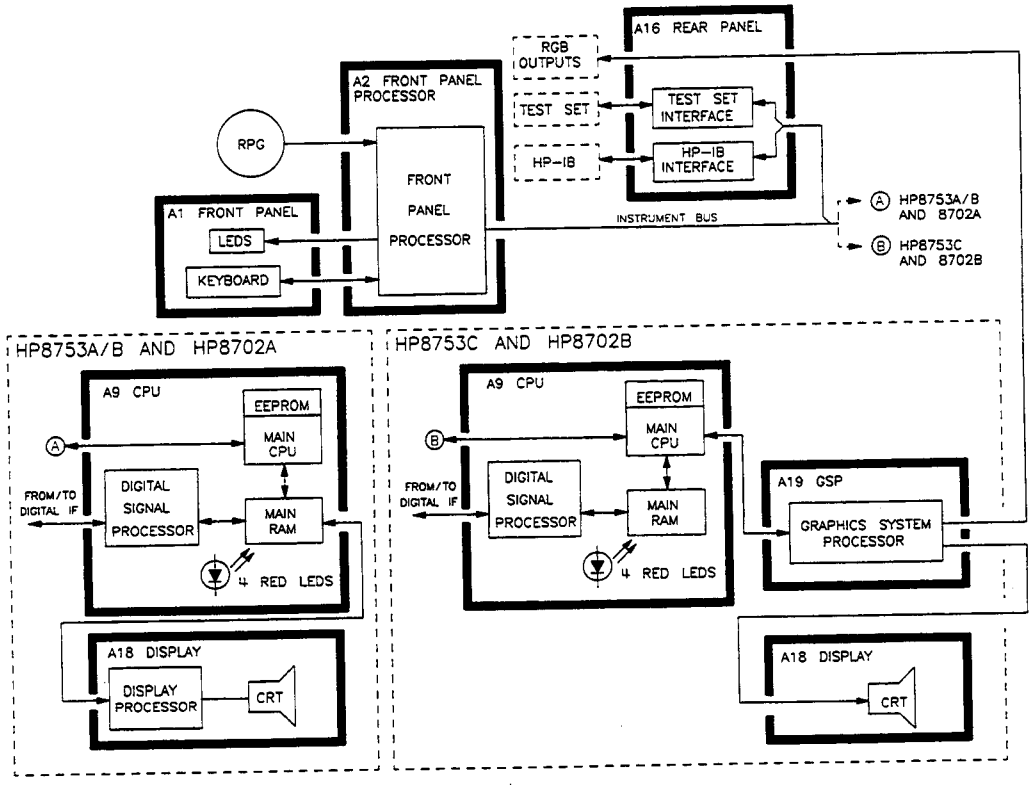


Figure 4. Digital Control Group, Simplified Block Diagram

A1 Front Panel

The A1 front panel assembly provides user interface with the analyzer. It includes the keyboard for local user inputs, and the front panel LEDs that indicate instrument status. The RPG (rotary pulse generator) is not electrically connected to the front panel, but provides user inputs directly to the front panel processor.

A2 Front Panel Processor

The A2 front panel processor detects and decodes user inputs from the front panel and the RPG, and transmits them to the CPU. It has the capability to interrupt the CPU to provide information updates. It controls the front panel LEDs that provide status information to the user. In the HP 8753A/B and 8702A it also contains auxiliary controls for the display focus and intensity, to enable softkey control of these features without mechanically adjusting the display assembly.

A9 CPU

The A9 CPU assembly contains the main CPU (central processing unit), the digital signal processor, and memory storage. The main CPU is the master controller for the analyzer, including the other dedicated microprocessors. The memory includes EEPROM, RAM, EPROM, and ROM.

Data from the receiver is serially clocked into the A9 CPU assembly from the A10 digital IF. The data taking sequence is triggered either from the A14 fractional-N assembly, externally from the rear panel, or by software on the A9 assembly.

Main CPU. The main CPU is a 16-bit microprocessor that maintains digital control over the entire instrument through the instrument bus. The main CPU receives external control information from the front panel or HP-IB, and performs processing and formatting operations on the raw data in the main RAM. It controls the digital signal processor, the front panel processor, the display processor, and the HP-IB interface. In addition, when the analyzer is the system controller, the main CPU controls peripheral devices through the HP-IB interface and HP-IB interconnections.

The main CPU has a dedicated EPROM that contains the operating system for instrument control. Front panel settings are stored in CMOS RAM, with a large capacitor providing at least 72 hours of backup storage when external power is off.

Main RAM HP 8753A/B and 8702A. The main RAM (random access memory) is shared memory for the CPU, the digital signal processor, and the display processor. It stores the raw data received from the digital signal processor, while additional calculations are performed on it by the CPU. The display processor reads the resulting formatted data from the main RAM and displays it on the CRT. The data is updated (refreshed) frequently, and asynchronously with the data processing operations, to provide a flicker-free image.

Main RAM HP 8753C and 8702B. The main RAM (random access memory) is shared memory for the CPU and the digital signal processor. It stores the raw data received from the digital signal processor, while additional calculations are performed on it by the CPU. The CPU reads the resulting formatted data from the main RAM and converts it to GSP commands. It writes these commands to the GSP for output to the CRT.

Detailed information on the data processing sequence is provided in chapter 1 of the *Reference*.

EEPROM. EEPROM (electrically-erasable programmable ROM) contains factory set correction constants unique to each instrument. These constants correct for hardware variations to maintain the highest measurement accuracy. The correction constants can be updated by executing the routines in the *Adjustments* section of this manual.

Digital Signal Processor. The digital signal processor receives the digitized data from the A10 digital IF. It computes discrete Fourier transforms to extract the complex phase and magnitude data from the 4 kHz IF signal. The resulting raw data is written into the main RAM.

A18 Display

HP 8753A/B and 8702A

The A18 display is an HP 1349A 20.8 cm (9 in) vector display with a dedicated microprocessor-controlled digital interface. It reads the formatted data from the main RAM on the A9 assembly and displays it on the CRT.

The A18 display receives three power supply voltages: +5VCPU, +15VDSP, and −15VDSP. The +15VDSP and −15VDSP supplies are unique to the display and are not used by any other assemblies; they are individually fused and regulated in the post-regulator assembly.

The display also includes the focus and intensity circuits that are controlled by the front panel interface.

HP 8753C and 8702B

The A18 display is a 7.5 inch raster scan CRT with associated drive circuitry. It receives a +65V power supply from the A19 GSP, along with digital TTL horizontal and vertical sync signals, and red, green, and blue (RGB) video signals. Automatic degaussing is performed whenever the instrument is turned on to minimize the magnetization of the CRT.

A19 GSP (HP 8753C and 8702B only)

The A19 graphics system processor provides an interface between the A9 CPU and the A18 display. The CPU (A9) converts the formatted data to GSP commands and writes it to the GSP. The GSP processes the data to obtain the necessary video signals and sends the signals to the A18 display. It also produces RGB output signals which are sent to the A16 rear panel. The assembly receives two power supply voltages: +5VCPU, which is used for processing, and +65V, which is passed on to A18 but not used on A19.

A16 Rear Panel

The A16 rear panel includes the HP-IB interface and the test set interface. The HP-IB interface circuit contains a dedicated bus controller that monitors and controls the handshake and data lines of the external bus. It communicates messages from a remote controller to the CPU, and from the CPU to peripherals on the bus. The test set interface, used with the HP 85047A and 85046A/B S-parameter test set, is controlled directly by the CPU. In the HP 8753C and 8702B, the A16 assembly also receives red, green, and blue video signals from the A19 GSP for output via 3 rear panel BNC connectors.

SOURCE THEORY OVERVIEW

The source produces a highly stable and accurate RF output signal by phase locking a YIG oscillator to a harmonic of the synthesized VCO (voltage controlled oscillator). The RF output is a CW or swept signal between 300 kHz and 3.0 GHz, with a maximum leveled power of +20 dBm (minimum −5 dBm).

The full frequency range of the source is produced in 11 subsweeps, two in low band and the others in high band. The high band frequencies (16 MHz to 3 GHz) are achieved by harmonic mixing, with a different harmonic number for each subsweep. The low band frequencies (300 kHz to 16 MHz) are down-converted by fundamental mixing.

The source functional group consists of the individual assemblies described below.

A14/A13 Fractional-N

These two assemblies comprise the synthesizer. The 30 to 60 MHz VCO in the A14 assembly generates the stable LO frequencies for fundamental and harmonic mixing.

A12 Reference

This assembly provides stable reference frequencies to the rest of the instrument by dividing down the output of a 40 MHz crystal oscillator. In low band operation, the output of the fractional-N synthesizer is mixed down in the A12 reference assembly. (The 2nd LO signal from the A12 assembly is explained in *Receiver Theory*.)

A7 Pulse Generator

A step recovery diode in the pulse generator produces a comb of harmonic multiples of the VCO output. These harmonics provide the high band LO (local oscillator) input to the samplers. In low band operation the pulse generator is turned off.

A11 Phase Lock

This assembly compares the first IF (derived from the RF output in the A4 sampler) to a stable reference, and generates an error voltage that is integrated into the drive for the A3 source assembly.

A3 Source

This assembly includes a 3.8 to 6.8 GHz YIG oscillator and a 3.8 GHz cavity oscillator. The outputs of these oscillators are mixed to produce the RF output signal. This signal tracks the stable output of the synthesizer. The ALC (automatic leveling control) circuitry is also in the A3 assembly.

A4 Sampler/Mixer

The A4 assembly is part of the receiver functional group. It is also included here because it is an integral part of the source phase locking scheme. For phase locking, a portion of the first IF signal from the A4 R input sampler is routed back to the A11 phase lock assembly. (Additional information on the sampler/mixer assemblies is provided in *Receiver Theory*.)

SOURCE HIGH BAND OPERATION

The high band frequency range is 16 MHz to 3.0 GHz. These frequencies are generated in subsweeps by phase-locking the A3 source signal to harmonic multiples of the fractional-N VCO. The high band subsweep sequence, illustrated in Figure 5, follows these steps, which are described in more detail below.

1. A signal (HI OUT) is generated by the fractional-N VCO.
2. A comb of harmonics (1st LO) is produced in the pulse generator.
3. The A3 source is pretuned. The signal (RF OUT) is fed to the A4 sampler.
4. A VCO harmonic (1st LO) and the source signal (RF OUT) are combined by the sampler. A difference frequency is generated.
5. The difference frequency (1st IF) from the A4 sampler is compared to a reference.
6. A tuning signal (YO DRIVE) tunes the source and phase lock is achieved.
7. A synthesized subsweep is generated by A13/A14. The A3 source tracks the synthesizer.

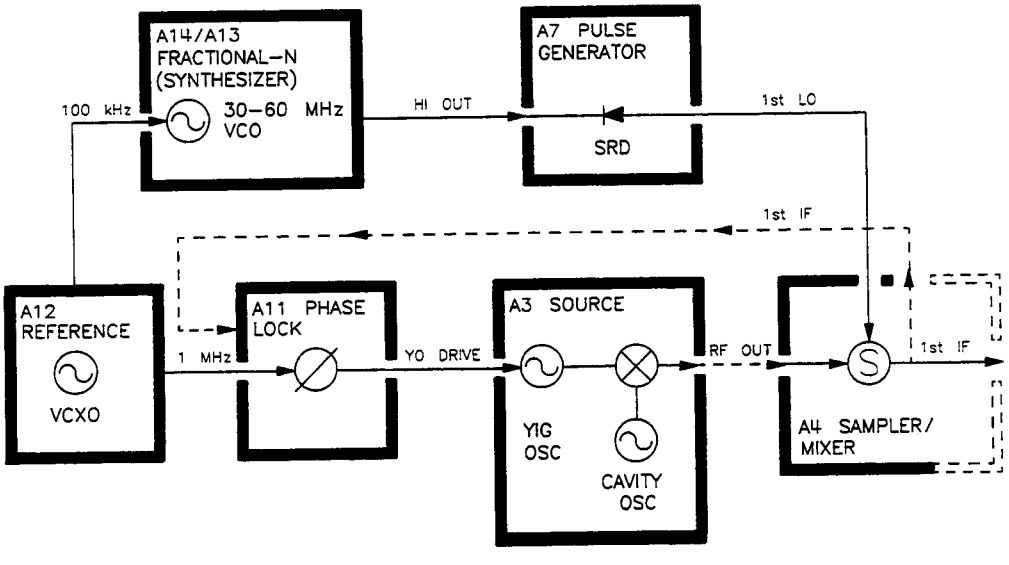


Figure 5. High Band Operation of the Source

1. A Signal Is Generated by the Fractional-N VCO. The VCO in the A14 fractional-N assembly generates a CW or swept signal in the range of 30 to 60 MHz. This signal is synthesized and phase locked to a 100 kHz reference signal from the A12 reference assembly.

The signal from the fractional-N VCO is divided by 1 or 2, and goes to the pulse generator.

2. A Comb of Harmonics is Produced in the Pulse Generator. The divided down signal from the fractional-N VCO drives a step recovery diode (SRD) in the A7 pulse generator assembly. The SRD multiplies the fundamental signal from the fractional-N into a comb of harmonic frequencies. The harmonics are used as the 1st LO (local oscillator) signal to the samplers. One of the harmonic signals is 1 MHz below the start signal set from the front panel.

3. The A3 Source Is Pretuned. The Signal Is Fed to the A4 Sampler. The pretune DAC in the A11 phase lock assembly sets the A3 source to a first approximation frequency 1 to 6 MHz higher than the start frequency. This signal (RF OUT) goes to the A4 R input sampler/mixer assembly. (The RF output MUST be connected externally to the R input connector for phase lock.)

4. The Synthesizer Signal and the Source Signal are Combined by the Sampler. A Difference Frequency Is Generated. In the A4 sampler, the 1st LO signal from the pulse generator is combined with the RF OUT signal from the source. The difference IF (intermediate frequency) produced is a first approximation of 1 MHz. This signal (1st IF) is routed back to the A11 phase lock assembly.

5. The Difference Frequency from the A4 Sampler is Compared to a Reference. The 1st IF feedback signal from the A4 is filtered and applied to a phase comparator circuit in the A11 phase lock assembly. The other input to the phase comparator is a crystal controlled 1 MHz signal from the A12 reference assembly. Any frequency difference between these two signals produces a proportional error voltage.

6. A Tuning Signal Tunes the Source and Phase Lock is Achieved. The error voltage is integrated into the drive for the A3 source YIG oscillator, to bring the YIG closer to the required frequency. The loop process continues until the 1st IF feedback signal to the phase comparator is equal to the 1 MHz reference signal, and phase lock is achieved.

7. A Subsweep is Generated. The Source Tracks the Synthesizer. When the source is phase locked to the synthesizer at the start frequency, the synthesizer starts to sweep. The phase-locked loop forces the source to track the synthesizer, maintaining a constant 1 MHz 1st IF signal.

The full high band sweep is generated in a series of subsweeps, by phase locking the A3 source signal to harmonic multiples of the fractional-N VCO. The 16 to 31 MHz subsweep is produced by a one half harmonic, using the divide-by-2 circuit on the A14 assembly. At the transitions between subsweeps, the source is pretuned and then relocks. Table 2 lists the high band subsweep frequencies from the fractional-N VCO and the RF output.

Table 2. High Band Subsweep Frequencies

Fractional-N (MHz)	Harmonic	RF Output (MHz)
30 to 60	1/2	16 to 31
30 to 60	1	31 to 61
30 to 60	2	61 to 121
40 to 59	3	121 to 178
35.4 to 59.2	5	178 to 296
32.8 to 59.4	9	296 to 536
35.7 to 59.5	15	536 to 893
33.0 to 59.5	27	893 to 1607
31.5 to 58.8	51	1607 to 3000

SOURCE LOW BAND OPERATION

The low band frequency range is 300 kHz to 16 MHz. These frequencies are generated by locking the A3 source to a reference signal. The reference signal is synthesized by mixing down the fundamental output of the fractional-N VCO with a 40 MHz crystal reference signal.

Low band operation differs from high band in these respects:

- The reference frequency for the A11 phase lock is not a fixed 1 MHz signal, but varies with the frequency of the fractional-N VCO signal.
- The sampler diodes are biased on to pass the signal through to the mixer.
- The 1st IF signal from the A4 sampler is not fixed but is identical to the RF output signal from the A3 source and sweeps with it.

The following steps outline the low band sweep sequence, illustrated in Figure 6. More detailed information is given below.

1. A signal (FN LO) is generated by the fractional-N VCO.
2. The fractional-N VCO signal is mixed with 40 MHz to produce a reference signal.
3. The A3 source is pretuned. The signal (RF OUT) is fed to the A4 sampler.
4. The signal from the source is fed back (1st IF) to the phase comparator.
5. A tuning signal (YO DRIVE) tunes the source and phase lock is achieved.
6. A synthesized subsweep is generated. The source tracks the synthesizer.

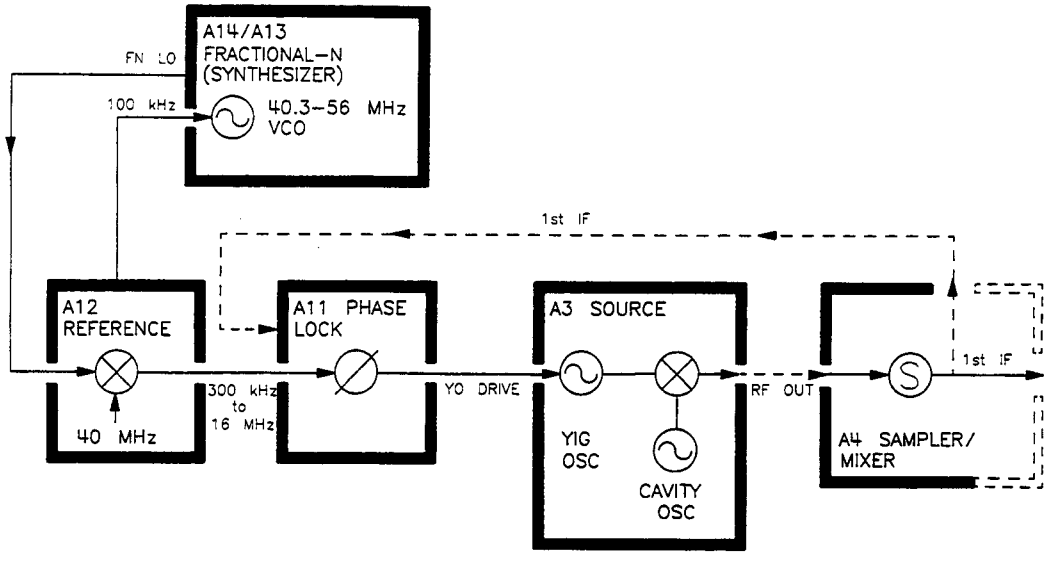


Figure 6. Low Band Operation of the Source

1. A Signal Is Generated by the Fractional-N VCO. The VCO in the A14 fractional-N assembly generates a CW or swept signal that is 40 MHz greater than the start frequency. The signal is divided down to 100 kHz and phase locked in the A13 assembly, as in high band operation.

2. The Fractional-N VCO Signal is Mixed with 40 MHz to Produce a Reference Signal. The signal (FN LO) from the fractional-N VCO goes to the A12 reference assembly, where it is mixed with the 40 MHz VCXO (voltage controlled crystal oscillator). The resulting signal is the reference to the phase comparator in the A11 assembly.

3. The A3 Source Is Pretuned. The Signal is Fed to the A4 Sampler. The pretune DAC in the A11 phase lock assembly sets the A3 source to a frequency 1 to 6 MHz above the start frequency. This signal (RF OUT) goes to the A4 R input sampler/mixer assembly. (The RF output MUST be connected externally to the R input connector.)

4. The Signal from the Source Is Fed Back to the Phase Comparator. The source RF OUT signal passes directly through the sampler in the A4 assembly, because the sampler is biased on. The signal (1st IF) is fed back unaltered to the phase comparator in the A11 phase lock assembly. The other input to the phase comparator is the heterodyned reference signal from the A12 assembly. Any frequency difference betwen these two signals produces a proportional error voltage.

5. A Tuning Signal Tunes the Source and Phase Lock Is Achieved. The error voltage is integrated into the drive for the A3 source YIG oscillator to bring the YIG closer to the reference frequency. The loop process continues until the source frequency and the reference frequency are the same, and phase lock is achieved.

6. A Synthesized Subsweep Is Generated. The Source Tracks the Synthesizer. When lock is achieved at the start frequency, the synthesizer starts to sweep. This changes the phase lock reference frequency, and causes the source to track at a difference frequency 40 MHz below the synthesizer.

The full low band sweep is produced in two subsweeps, to allow additional IF filtering below 3 MHz. At the transition between subsweeps, the source is pretuned and then relocks. Table 3 lists the low band subsweep frequencies at the fractional-N VCO and the RF output.

Table 3. Low Band Subsweep Frequencies

Fractional-N (MHz)	1st IF (MHz)	RF Output (MHz)
40.3 to 43.3 43.3 to 56	0.3 to 3.3 3.3 to 16	0.3 to 3.3 3.3 to 16

SOURCE OPERATION IN OTHER MODES/FEATURES (HP 8753B/C ONLY)

Besides the normal network analyzer mode, the HP 8753B/C has extra modes and features to make additional types of measurements. The following describes the key differences in how the analyzer operates to achieve these new measurements.

Frequency Offset

The analyzer can measure frequency-translating devices with the frequency offset feature.

The receiver operates normally. However, the source is pretuned to a different frequency by an offset entered by the user. The device under test will translate this frequency back to the frequency the receiver expects. Otherwise, phase locking and source operation occur as usual.

Harmonic Analysis (Option 002)

The analyzer can measure the 2nd or 3rd harmonic of the fundamental source frequency, on a swept or CW basis, with the harmonic analysis feature (optional).

To make this measurement, the reference frequency (normally 1 MHz) from the A12 reference assembly to the A11 phase lock assembly is divided by 1, 2, or 3. See Figure 7 and the accompanying table.

The fractional-N assemblies are also tuned so that the correct harmonic (comb tooth) of the 1st LO is 0.500 or 0.333 MHz below the source frequency – instead of the usual 1.000 MHz. The analyzer pretunes the A3 source normally, then phase locks the 1st IF to the new reference frequency to sweep the *fundamental* source frequency in the usual way. The key difference is that the 1st IF (output from the R sampler) – due to the *fundamental* and used for phase locking – is now 0.500 or 0.333 MHz instead of 1.000 MHz.

Since the chosen VCO harmonic and the source differ by 0.500 or 0.333 MHz, then *another* VCO harmonic, 2 or 3 times higher in frequency, will be exactly 1.000 MHz away from the 2nd or 3rd harmonic of the source frequency. The samplers, then, will also down-convert these harmonics to yield the desired components in the 1st IF at 1.000 MHz. Narrow bandpass filters in the receiver eliminate all but the 1.000 MHz signals; these pass through to be processed and displayed.

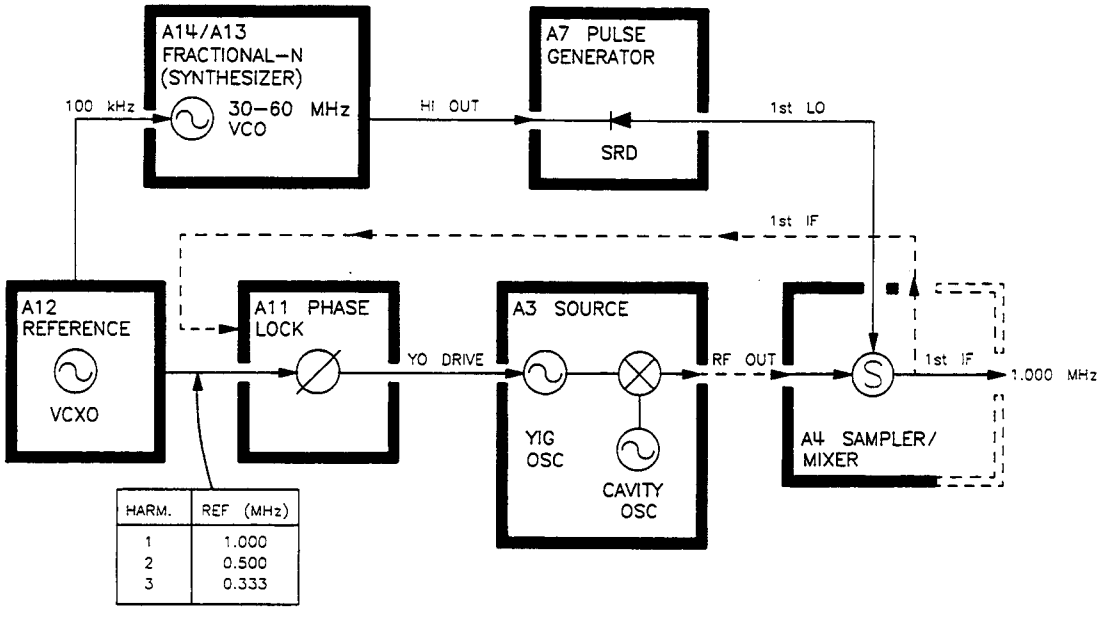


Figure 7. Harmonic Analysis

External Source Mode

In external source mode, the analyzer phase locks its receiver to an external signal source. This source must be CW (not swept), but it does not need to be synthesized. The user must enter the source frequency into the analyzer. (The analyzer's internal source output is not used.)

To accomplish this, the phase lock loop is reconnected so that the tuning voltage from the A11 phase lock assembly controls the VCO of the A14 fractional-N assembly – *not* the A3 source. See Figure 8. The VCO's output still drives the 1st LO of the samplers and down-converts the RF signal supplied by the external source. The resulting 1st IF is fed back to the A11 phase lock assembly, compared to the 1.000 MHz reference, and used to generate a tuning voltage – as usual. However, the tuning voltage controls the VCO to lock on to the external source, keeping the 1st IF at exactly 1.000 MHz.

The analyzer normally goes through a pretune-acquire-track sequence to achieve phase lock. In external source mode, the fractional-N VCO *pretunes* as a closed-loop synthesizer referenced to the 100 kHz signal from the A12 reference assembly. Then, to *acquire* or *track*, a switch causes the VCO to be tuned by the A11 phase lock assembly instead. (See *Overall Block Diagram*.)

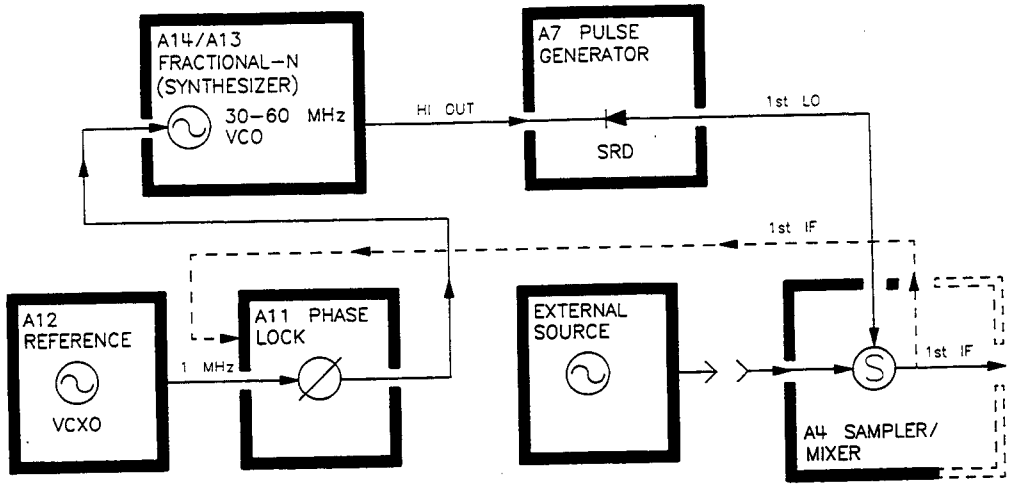


Figure 8. External Source Mode

Tuned Receiver Mode

In tuned receiver mode, the analyzer is a synthesized, swept, narrow-band receiver only. The external signal source must be synthesized and reference-locked to the analyzer.

To achieve this, the analyzer's source and phase lock circuits are completely unused. See Figure 9. The fractional-N synthesizer is tuned so that one of its harmonics (1st LO) down-converts the RF input to the samplers. (In contrast to external source mode, the analyzer does not phase lock at all. However, the 1st LO *is* synthesized.)

The analyzer can function as a *swept* tuned receiver, similar to a spectrum analyzer, but the samplers create spurious signals at certain frequencies, which limit the accuracy of such measurements.

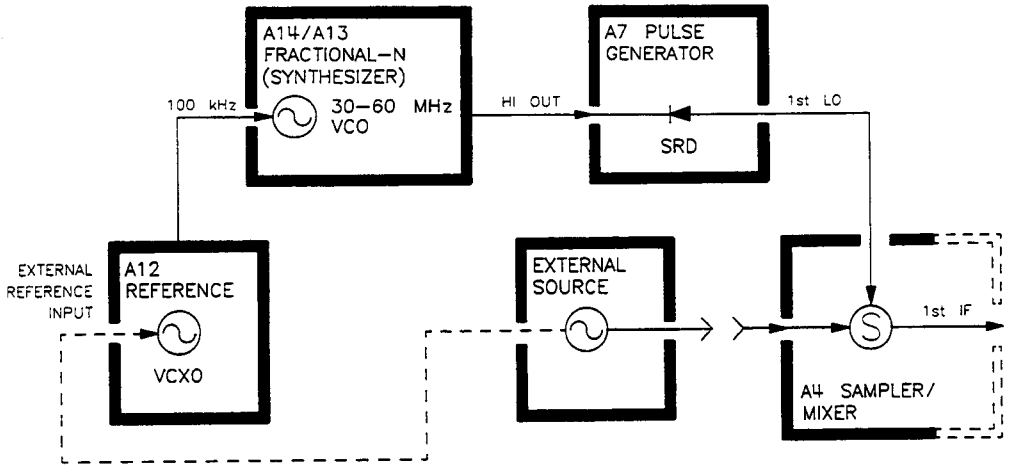


Figure 9. Tuned Receiver Mode

6 GHz OPERATION (OPTION 006 HP 8753B/C and 8702)

Operation to 6 GHz is accomplished with an *external* frequency doubler (in a test set). The analyzer A3 source still has an upper frequency limit of 3 GHz.

In the 6 GHz mode, the pretuned A3 source frequency is *half* what the receiver is expecting, and the harmonics used are slightly altered. Table 4 lists the key frequencies in each subsweep for 6 GHz mode. Receiver operation is the same as normal, but extended to 6 GHz.

Table 4. Subsweep Frequencies for 6 GHz Mode

Fractional-N (MHz)	Harmonic	RF Input (MHz)	RF Output (MHz)
43 to 56	—	3 to 16	1.5 to 8
30 to 60	1/2	16 to 31	8 to 15.5
30 to 45	1	31 to 46	15.5 to 23
30 to 60	3/2	46 to 91	23 to 45.5
30 to 59	3	91 to 178	45.5 to 89
35.4 to 59.2	5	178 to 296	89 to 148
32.8 to 59.4	9	296 to 536	148 to 268
35.7 to 59.5	15	536 to 893	268 to 446.5
33.0 to 59.5	27	893 to 1607	446.5 to 803.5
31.5 to 60	51	1607 to 3060	803.5 to 1530
30.3 to 59.4	101	3060 to 6000	1530 to 3000

RECEIVER THEORY

The receiver functional group consists of the following assemblies:

A4 sampler/mixer
A5 sampler/mixer
A6 sampler/mixer
A10 digital IF

These assemblies combine with the A9 CPU (described in *Digital Control Theory*) to measure and process input signals into digital information for display on the CRT. Figure 10 is a simplified block diagram of the receiver functional group. The A12 reference assembly is also included in the illustration to show how the 2nd LO signal is derived.

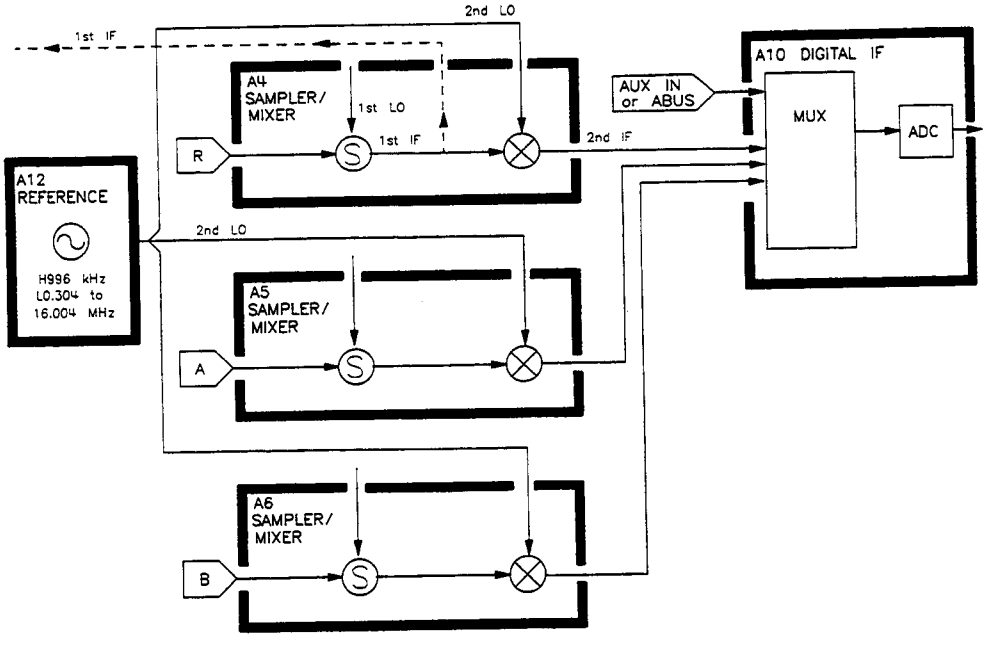


Figure 10. Receiver Functional Group, Simplified Block Diagram

A4/A5/A6 Sampler/Mixer

The A4, A5, and A6 sampler/mixers are identical assemblies that down-convert the RF input signals to a fixed 4 kHz 2nd IF with amplitude and phase corresponding to the RF input. Each assembly contains a sampler circuit and a mixer circuit. The RF signal from the front panel input connectors is first applied to the sampler circuit. Operation of the samplers differs in high band and low band operation.

The Sampler Circuit in High Band. In high band operation, the sampling rate of the samplers is controlled by the 1st LO from the A7 pulse generator assembly. The 1st LO is a comb of harmonics produced by a step recovery diode driven by the fractional-N VCO fundamental signal. One of the harmonic signals is 1 MHz below the start frequency set at the front panel. The 1st LO is combined in the samplers with the RF input signal (300 kHz to 3 GHz) from the source. In the Option 006, samplers are additionally capable of recognizing RF input signals from 3 to 6 GHz. The mixing products are filtered, so that the only remaining response is the difference between the source frequency and the harmonic 1 MHz below it. This fixed 1 MHz signal is the 1st IF. Part of the 1st IF signal from the R sampler is fed back to the A11 phase lock assembly (the RF output MUST be connected externally to the R input connector for phase-locked operation).

The Sampler Circuit in Low Band. In low band the sampler diodes are biased continuously on, so that the RF input signal passes through them unchanged. Thus the 1st IF is identical to the RF output signal from the source (between 300 kHz and 16 MHz), and sweeps with it. Part of the 1st IF signal from the R sampler is fed back to the A11 phase lock assembly.

(Refer to *Source Theory* for information on high band and low band operation of the source.)

The 2nd LO Signal. The 2nd LO is obtained from the A12 reference assembly. In high band, the 2nd LO is fixed at 996 kHz. This is produced by feeding the 39.84 MHz output of a phase-locked oscillator in the A12 assembly through a divide-by-40 circuit.

In low band, the 2nd LO is a variable frequency produced by mixing the output of the fractional-N VCO with a fixed 39.996 MHz signal in the A12 assembly. The 2nd LO covers the range of 0.304 to 16.004 MHz in two subsweeps that correspond with the source subsweeps. These subsweeps are 0.304 to 3.304 MHz and 3.304 to 16.004 MHz.

The Mixer Circuit. The 1st IF and the 2nd LO are combined in the mixer circuit. The resulting difference frequency (the 2nd IF) is a constant 4 kHz in both bands, as this table shows.

Band	1st IF	2nd LO	2nd IF
High	1.000 MHz	996 kHz	4 kHz
Low	0.300 to 16 MHz	0.304 to 16.004 MHz	4 kHz

A10 Digital IF

The three 4 kHz 2nd IF signals from the sampler/mixer assemblies are input to the A10 digital IF assembly. These signals are sampled at a 16 kHz rate. A fourth input is the analog bus, which can monitor either an external input at the rear panel AUX IN connector, or one of 31 internal nodes. A multiplexer sequentially directs each of the signals to the ADC (analog-to-digital converter). Here they are converted to digital form and sent to the A9 CPU assembly for processing. Refer to *Digital Control Theory* for more information on signal processing.

REPAIR SEQUENCE

Troubleshooting: Identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

This section contains information for ordering replaceable parts. Analyzer replaceable parts include major assemblies and all chassis hardware. In general, parts of major assemblies are not included. Table 1 lists major reference designations and abbreviations to help interpret part descriptions in the replaceable parts lists that follow. Table 1 also contains names and addresses that correspond to manufacturer code numbers listed after each replaceable part.

REBUILT-EXCHANGE ASSEMBLIES

Under the rebuilt-exchange assembly program, certain factory-repaired and tested modules (assemblies) are available on a trade-in basis. These assemblies are offered for lower cost than a new assembly, but meet all factory specifications required of a new assembly.

The defective assembly must be returned for credit under the terms of the rebuilt-exchange assembly program. Any spare assembly stock desired should be ordered using the new assembly part number. Figure 1 illustrates the module exchange procedure. Figure 2 shows all major assemblies, including those that can be replaced on an exchange basis.

REPLACEABLE PARTS LIST

Figures 2 through 18 assist in location and identification of all analyzer replaceable parts. Table 2 is a list of miscellaneous replaceable accessories. Figures 2 through 18 include corresponding lists that provide the following information:

1. Hewlett-Packard part number.
2. Part number check digit (CD).
3. Part quantity as shown in the corresponding figure. There may or may not be more of the same part located elsewhere in the instrument.
4. Part description, using abbreviations in Table 1.
5. A typical manufacturer of the part in a five-digit code (refer to the Manufacturers Code List in Table 1 for addresses).
6. The manufacturer's part number.

ORDERING INFORMATION

To order a part listed in the replaceable parts lists, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts lists, include the instrument model number, complete instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Table 1. Reference Designations, Abbreviations, and Manufacturers Code List (1 of 2)

REFERENCE DESIGNATIONS

A . . . . . Assembly
AT . . . . . Attenuator, Isolator, Limiter, Termination
B . . . . . Fan, Motor
C . . . . . Capacitor
CP . . . . . Coupler
CR . . Diode, Diode Thyristor, Step Recovery Diode (SCR), Varactor
DS . Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device (Audible or Visible)
E . . . . . Miscellaneous Electrical Part
F . . . . . Fuse
FL . . . . . Filter
H . . . . . Hardware
J . . . . . Electrical Connector (Stationary Portion), Jack
K . . . . . Relay
L . . . . . Coil, Inductor
M . . . . . Meter
MP . . . . . Miscellaneous Mechanical Part
P . . . . . Electrical Connector (Movable Portion), Plug
Q . . . . . Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor
R . . . . . Resistor
RT . . . . . Thermistor
S . . . . . Switch
T . . . . . Transformer
TB . . . . . Terminal Board
TP . . . . . Test Point
U . . . . . Integrated Circuit, Microcircuit
V . . . . . Electron Tube
VR . . . . . Breakdown Diode (Zener), Voltage Regulator
W . . . . . Cable, Transmission Path, Wire
X . . . . . Socket
Y . . . . . Crystal Unit (Piezoelectric, Quartz)
Z . Tuned Cavity, Tuned Circuit

ABBREVIATIONS

A

ADJ . . . . . Adjust, Adjustment
AL . . . . . Aluminum
AMP . . . . . Amperage
ANDZ . . . . . Anodized

B

BCKT . . . . . Bracket
BD . . . . . Board, Bundle
BNC . . . . . Type of Connector

C

C . . . Capacitance, Capacitor, Center Tapped, Centistoke, Ceramic, Cermet, Circular Mil Foot, Closed Cup, Cold, Compression
CBL . . . . . Cable
CER . . . . . Ceramic
CHAM . . . . . Chamfer
CHAN . . . . . Channel
COM . . . . . Commercial, Common
CONN . Connect, Connection, Connector
CONT . . . . . Contact, Continuous, Control, Controller
CRP . . . . . Crepe, Crimp
CTR . . . . . Center
CURRNT . . . . . Current

D

D . . . Deep, Depletion, Depth, Diameter, Direct Current
DB . . . Decibel, Double Break
DBL . . . . . Double
DEG . . . . . Degree

E

EXCL . . Excluding, Exclusive
EXT . . . Extended, Extension, External, Extinguish

F

F . Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency
FDTHRU . . . . . Feed Through
FF . . . . . Flange, Female Connection; Flip Flop
FL . . . . . Flash, Flat, Fluid
FLEX . . . . . Flexible
FLG . . . . . Flange
FLTR . . . . . Filter, Floater
FT . . Current Gain Bandwidth Product (Transition Frequency); Feet, Foot
FXD . . . . . Fixed

G

GEN . . . . General, Generator
GHZ . . . . . Gigahertz
GP . . General Purpose Group
GRN . . . . . Green
GRV . . . . . Grooved

H

H . . . . Henry, Hermaphrodite, High, Hole Diameter, Hot, Hub Inside Diameter, Hydrogen
HD Hand, Hard, Head, Heavy Duty
HEX . Hexadecimal, Hexagon, Hexagonal
HGT . . . . . Height

I

ID . . . . . Identification, Inside Diameter
IN . . . . . Inch, Indium
INS . Insert, Inside, Insulation, Insulator
INT . . . . . Integral, Intensity, Internal
INTL . . . . . Internal, International

K

K . . . . . Kelvin, Key, Kilo, Potassium
KB . . . . . Knob

Table 1. Reference Designations, Abbreviations, and Manufacturers Code List (2 of 2)

L

LED . . Light Emitting Diode
LG ..... Length, Long
LKG ..... Leakage, Locking
LKWR ..... Lockwasher

M

M ... Male, Maximum, Mega, Mil, Milli, Mode, Momentary, Mounting Hole Centers, Mounting Hole Diameter
MA ..... Milliampere
MIN .... Miniature, Minimum, Minor, Minute
MLD ..... Mold, Molded
MM .... Magnetized Material (Restricted Articles Code), Millimeter
MO . Metal Oxide, Milliounce, Molybdenum
MOM ..... Momentary, Motherboard
MTG ..... Mounting
MTLC ..... Metallic
MULTR ..... Multiplier
MW ..... Milliwatt

N

NB ..... Niobium
NCH ..... Notched
NEG ..... Negative
NH ..... Nanohenry
NM . Nanometer, Nonmetallic
NS ..... Nanosecond, Non-Shorting, Nose
NYL ..... Nylon (Polyamide)

O

OD ..... Olive Drab, Outside Diameter Amplifier

P

PAN-HD ..... Pan Head
PC ..... Picocoulomb, Piece, Printed Circuit
P.C. ..... Printed Circuit
PCB ... Printed Circuit Board
PD .... Pad, Palladium, Pitch Diameter, Power Dissipation
PF .. Picofarad; Pipe, Female Connection; Power Factor
PKG ..... Package
PL-MTG .... Plate Mounting
PLSTC ..... Plastic
PN ..... Part Number
POLYC ..... Polycarbonate
POLYE ..... Polyester
POLYI ..... Polyimide
POS ..... Position, Positive
POZI ..... Pozidrive Recess
PRCN ..... Precision
PRIM ..... Primary
PRL ..... Parallel
PRP ..... Purple, Purpose
P/S ..... Power Supply
PT Part, Pint, Platinum, Point, Pulse Time
PVC ..... Polyvinyl Chloride

Q

QUAD ..... Set of Four

R

RBN ..... Ribbon
RCVR ..... Receiver
RECT ..... Rectangle, Rectangular, Rectifier
RFI ..... Radio Frequency Interference
RND ..... Round
RVT ..... Rivet, Riveted

S

SCR .. Screw, Scrub, Silicon Controlled Rectifier
SEC ..... Secondary
SER ..... Serial, Series
SGL ..... Single
SHFT ..... Shaft
SHLDR ..... Shoulder
SIG ..... Signal, Significant
SKT ..... Skirt, Socket
SLDR ..... Solder
SM ..... Samarium, Seam, Small, Square Meter, Sub Modular, Subminiature
SMB .. Subminiature, B Type (Snap-On Connector)
SNP ..... Snap
SPCL ..... Special
SQ ..... Square
SST ..... Stainless Steel
STDF ..... Standoff
SZ ..... Size

T

T .. Tab Width, Taper, Teeth, Temperature, Tera, Tesla, Thermoplastic (Insulation), Thickness, Time, Timed, Tooth, Turns Ratio, Typical
TA ... Ambient Temperature, Tantalum
TC ..... Thermoplastic
TFE Polytetrafluro - ethylene, Teflon
THD ..... Thread, Threaded
THK ..... Thick
TR ..... Rise Time, Truss
TRN ..... Turn, Turns

U

UCD ..... Microcandela

V

VDC ... Volts, Direct Current

W

W .... Watt, Wattage, White, Wide, Width, Wire
WD ..... Width, Wood

X

XSTR ..... Transistor

Y

YIG ..... Yytrium-iron-garnet

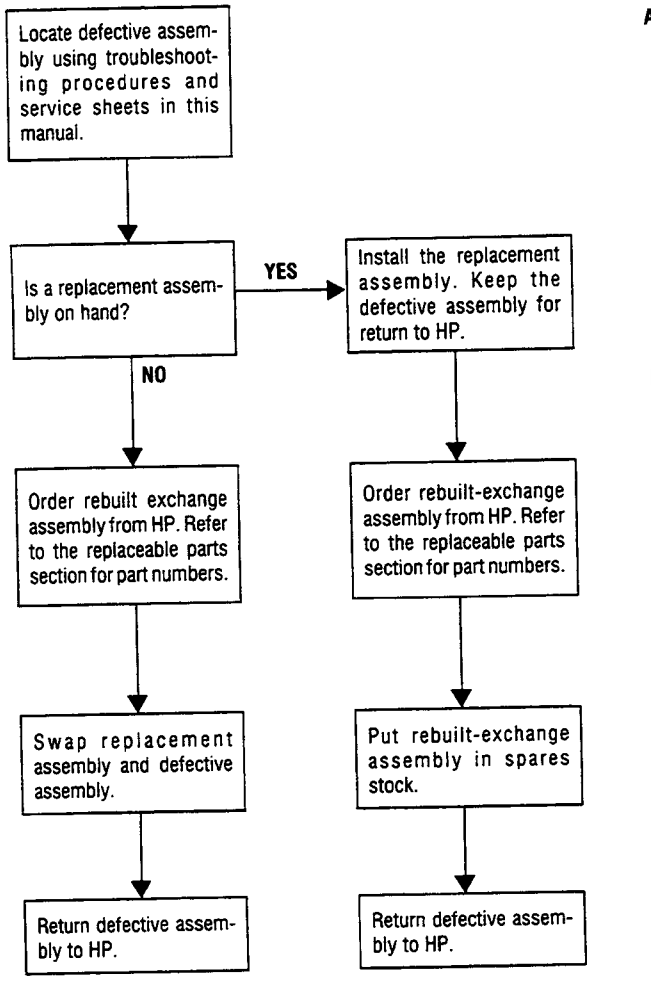
Z

ZN-P ..... Zinc Plate

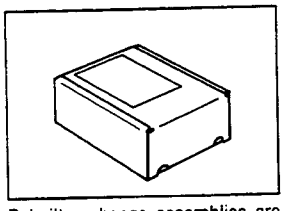
MANUFACTURERS CODE LIST

Mfr. Code	Manufacturer Name	Address		Zip Code
00000	Any Satisfactory Supplier			
02805	Cooper Industries Inc.	Houston	TX	77210
06324	Glenair Inc.	Glendale	CA	91201
28480	Hewlett-Packard Company Corp. Hq.	Palo Alto	CA	94304

Use this fast, efficient, economical method to keep your Hewlett-Packard instrument in service.

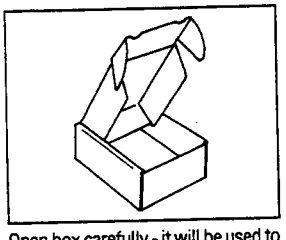

Locate defective assembly using troubleshooting procedures and service sheets in this manual.
Is a replacement assembly on hand?
YES
NO
Install the replacement assembly. Keep the defective assembly for return to HP.
Order rebuilt exchange assembly from HP. Refer to the replaceable parts section for part numbers.
Order rebuilt-exchange assembly from HP. Refer to the replaceable parts section for part numbers.
Swap replacement assembly and defective assembly.
Put rebuilt-exchange assembly in spares stock.
Return defective assembly to HP.
Return defective assembly to HP.

A.



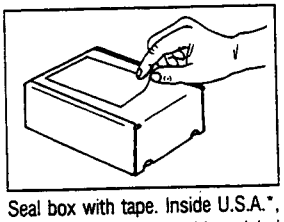
Rebuilt-exchange assemblies are shipped individually in boxes like this. In addition to the circuit assembly, the box contains:
Exchange assembly failure report
Return address label

B.



Open box carefully - it will be used to return defective assembly to HP. Complete failure report. Place it and defective assembly in box. Be sure to remove enclosed return address label.

C.



Seal box with tape. Inside U.S.A.*, stick preprinted return address label over label already on box, and return box to HP. Outside U.S.A., do not use address label; instead address box to the nearest HP office.

*HP pays postage on boxes mailed in U.S.A.

Figure 1. Module Exchange Procedure

HP 8753C shown. All analyzer's can use this figure with the exceptions noted.

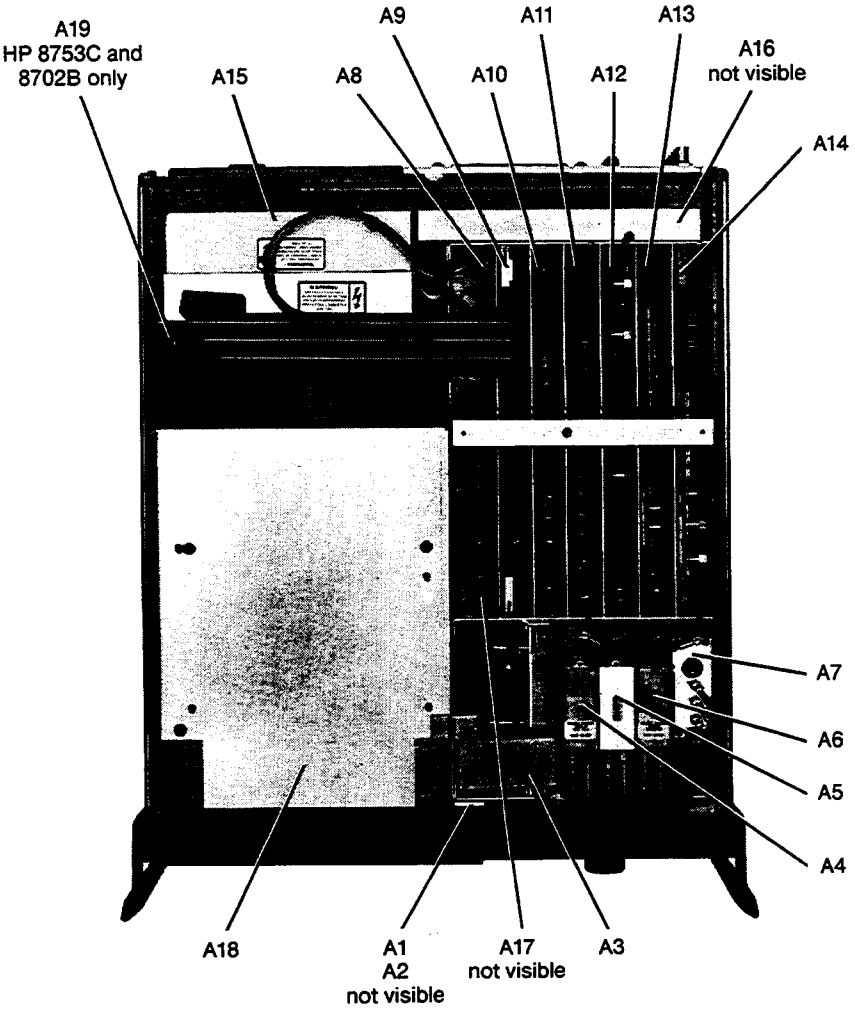


Figure 2. Major Assemblies (1 of 3)

Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08753-60001	9	1	HP 8753A/B AND 8702A FRONT PANEL KEYBOARD ASSY	28480	08753-60001
A1	08753-60090	6	1	HP 8753C AND 8702B FRONT PANEL KEYBOARD ASSY	28480	08753-60090
A2†	08753-60076	8	1	HP 8753A/B AND 8702A FRONT PANEL INTERFACE BOARD ASSY	28480	08753-60076
A2	08753-60091	7	1	HP 8753C AND 8702B FRONT PNL INTERFACE BD ASSY	28480	08753-60091
A3	08753-60084	8	1	SOURCE ASSY	28480	08753-60084
A3	08753-69003	9		SOURCE ASSY (REBUILT-EXCHANGE)	28480	08753-69003
A4†	08753-60004	2	1	SAMPLER ASSY	28480	08753-60004
A4†	08753-69004	0		SAMPLER ASSY (REBUILT-EXCHANGE) (INCLUDES SAMPLER/MIXER, BOARD, AND BOARD COVER)	28480	08753-69004
A5†	08753-60004	2	1	SAMPLER ASSY	28480	08753-60004
A5†	08753-69004	0		SAMPLER ASSY (REBUILT-EXCHANGE) (INCLUDES SAMPLER/MIXER, BOARD, AND BOARD COVER)	28480	08753-69004
A6†	08753-60004	2	1	SAMPLER ASSY	28480	08753-60004
A6†	08753-69004	0		SAMPLER ASSY (REBUILT-EXCHANGE) (INCLUDES SAMPLER/MIXER, BOARD, AND BOARD COVER)	28480	08753-69004
A7	08753-60007	5	1	PULSE GENERATOR BOARD ASSY	28480	08753-60007
A7	08753-69007	3		PULSE GENERATOR BOARD ASSY REBUILT-EXCHANGE (INCLUDES BOARD AND BOARD COVER)	28480	08753-69007
A8*	08753-60093	9	1	HP 8753A/B AND 8702A POST-REGULATOR BOARD ASSY	28480	08753-60093
A8	08753-69093			HP 8753A/B AND A702A POST-REGULATOR BOARD ASSY (REBUILT-EXCHANGE	28480	08753-69093
A8	08753-60208	8	1	HP 8753C AND 8702B POST-REGULATOR BD ASSY	28480	08753-60208
A8	08753-69208	6	1	HP 8753C AND 8702B POST-REGULATOR BD ASSY (REBUILT-EXCHANGE)	28480	08753-69208
A9	08753-60085	9	1	HP 8753A CPU BD ASSY	28480	08753-60085
A9	08753-69085	5		HP 8753A CPU BD ASSY (REBUILT-EXCHANGE)	28480	08753-69085
A9	08753-60067	7	1	HP 8753B CPU BD ASSY	28480	08753-60067
A9	08753-69067	5		HP 8753B CPU BD ASSY (REBUILT-EXCHANGE)	28480	08753-69067
A9†	08753-60138		1	HP 8753C CPU BD ASSY	28480	08753-60138
A9†	08753-69138			HP 8753C CPU BD ASSY (REBUILT-EXCHANGE)	28480	08753-69138
A9	08702-60002	9	1	HP 8702A CPU BD ASSY	28480	08702-60002
A9	08702-69002	7		HP 8702A CPU BD ASSY (REBUILT-EXCHANGE)	28480	08702-69002
A9	08702-60007	4	1	HP 8702B CPU BD ASSY	28480	08702-60007
A9	08702-69007	2	1	HP 8702B CPU BD ASSY (REBUILT-EXCHANGE)	28480	08702-69007
A9	08753-60126	9		HP 8753B REV 3.0 CPU BD KIT	28480	08753-60126
A9	08753-69129	0		HP 8753B REV 3.0 CPU BD ASSY (REBUILT-EXCHANGE)	28480	08753-69129
A10	08753-60095	0	1	DIGITAL IF BOARD ASSY	28480	08753-60095
A10	08753-69095	8		DIGITAL IF BOARD ASSY (REBUILT-EXCHANGE)	28480	08753-69095
A11	08753-60086	0		PHASE LOCK ASSY KIT (FOR 8753A WITH REV 1.00 FIRMWARE)	28480	08753-60086
A11	08753-60101	0	1	PHASE LOCK ASSY (FOR 8753B/C AND 8702A/B. ALSO FOR 8753A WITH FIRMWARE REV 1.01 OR ABOVE)	28480	08753-60101
A11	08753-60207	0		PHASELOCK ASSY (FOR 8753B REV 3.0 OR 8753C REV 4.02 OR HIGHER)	28480	08753-60207
A12	08753-60012	2	1	REFERENCE BOARD ASSY	28480	08753-60012
A12	08753-69012	0		REFERENCE BOARD ASSY (REBUILT-EXCHANGE)	28480	08753-69012
A13	08753-60013	3	1	FRACTIONAL N ANALOG BOARD ASSY	28480	08753-60013
A13	08753-69013	1		FRACTIONAL N ANALOG BOARD ASSY (REBUILT-EXCHANGE)	28480	08753-69013
A14\J	08753-60068	8	1	FRACTIONAL N DIGITAL BOARD ASSY	28480	08753-60068
A15	08753-60015	5	1	HP 8753A/B AND 8702A PREREGULATOR ASSY	28480	08753-60015
A15	08753-60098	4	1	HP 8753C AND 8702B PREREGULATOR ASSY	28480	08753-60098
A15	08753-69015	3		HP 8753A/B AND 8702A PREREGULATOR ASSY (REBUILT-EXCHANGE)	28480	08753-69015
A15	08753-69098	2	1	HP 8753C AND 8702B PREREGULATOR ASSY (REBUILT-EXCHANGE)	28480	08753-69098
				†Recommended Replacement		
				* When replacing A8 assembly 08753-60108, replace with the A8 assembly listed here. In addition, you must order the fan replacement kit, HP part number 08753-60100.		

Figure 2. Major Assemblies (2 of 3)

Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16	08753-60016	6	1	HP 8753A/B AND 8702A REAR PANEL BOARD ASSEMBLY	28480	08753-60016
A16	08752-60013		1	HP 8753C AND 8702B REAR PANEL BD ASSY	28480	08752-60013
A17	08753-60097	3	1	HP 8753A/B AND 8702A MOTHERBOARD ASSEMBLY (INCLUDES MOTHERBOARD RIVETED TO CAGE ASSEMBLY AND FRAME).	28480	08753-60097
A17	08753-60130	7	1	HP 8753C AND 8702B MOTHERBOARD ASSY (INCLUDES MOTHERBOARD RIVETED TO CAGE ASSY AND FRAME)	28480	08753-60130
A18	2090-0210	7	1	HP 8753C AND 8702B DISPLAY ASSY	28480	2090-0210
A18	5180-8484	7	1	HP 8753C AND 8702B DISPLAY ASSY RB	28480	5180-8484
A18	08753-60066	6	1	HP 8753A/B AND 8702A DISPLAY ASSEMBLY (SEE FIGURE 3)	28480	08753-60066
A18	08753-69066	4		HP 8753A/B AND 8702A DISPLAY ASSEMBLY (REBUILT-EXCHANGE)	28480	08753-69066
A19	08753-60202	2	1	HP 8753C AND 8702B GSP ASSY	28480	08753-60202
A19	08753-69202	0	1	HP 8753C AND 8702B GSP ASSY (REBUILT-EXCHANGE)	28480	08753-69202
MP1	5818-5525	3	1	SPRING CLIP FOR A19 ASSY	28480	5181-5525
	08753-60083	7		HP 8753A FIRMWARE KIT	28480	08753-60083
	08753-60088	2		HP 8753B REV 2.01 FIRMWARE KIT	28480	08753-60088
	08753-60127	0		HP 8753B REV 3.0 FIRMWARE KIT	28480	08753-61027
	08753-60120	3		HP 8753C FIRMWARE KIT	28480	08753-60120
				†Recommended Replacement		
				* When replacing A8 assembly 08753-60108, replace with the A8 assembly listed here. In addition, you must order the fan replacement kit, HP part number 08753-60100.		

Figure 2. Major Assemblies (3 of 3)

HP 8753B shown. All analyzer's can use this figure with the exceptions noted.

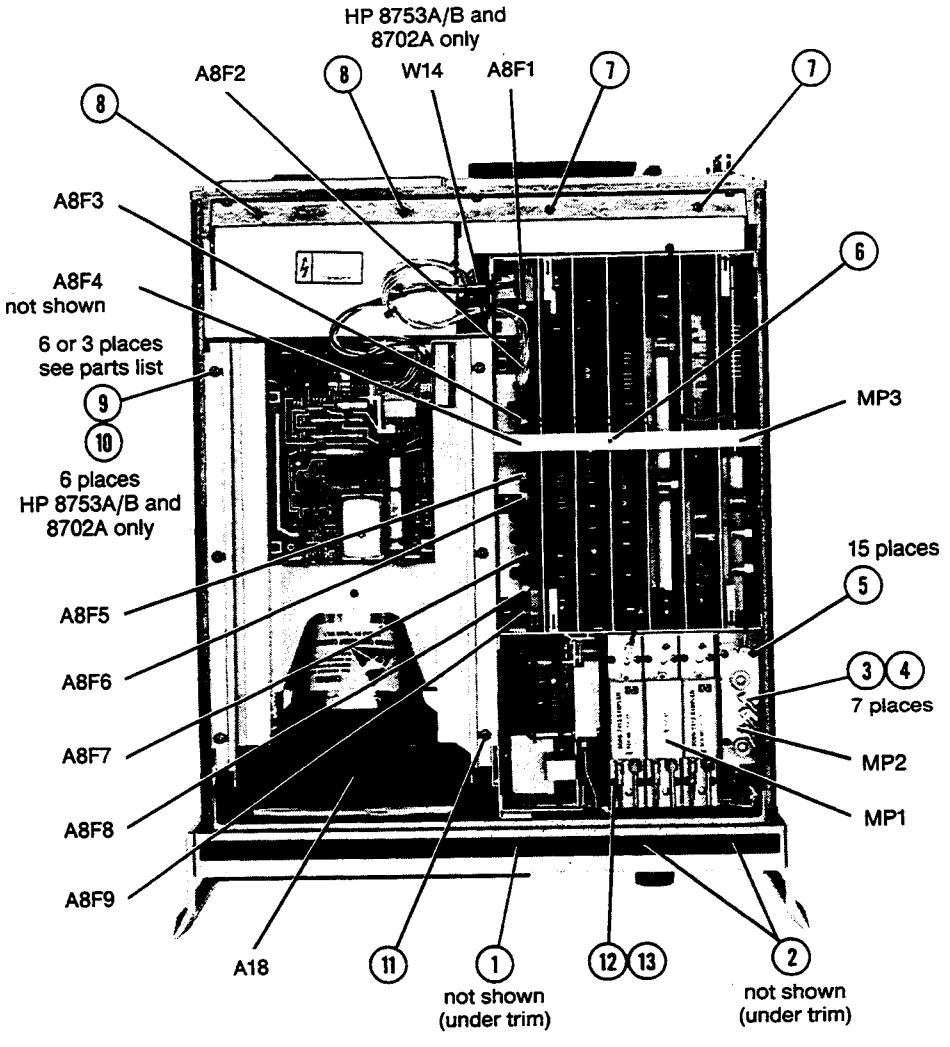


Figure 3. Top View, Attaching Hardware (1 of 2)

Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1331	5	1	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
2*	0515-1234	7	2	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
3	2190-0124	4	7	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
4	2950-0078	9	7	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
5*	0515-0169	5	15	SCREW-MACHINE ASSEMBLY M3 X 0.5 10MM-LG	00000	Order by Desc.
6*	0515-1110	8	1	SCREW-MACH M3 X 0.5 12MM-LG PAN-HD	28480	0515-1110
7*	0515-1232	5	2	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
8*	0515-1091	4	2	SCREW-MACHINE ASSEMBLY M3.5 X 0.6	28480	0515-1091
9*	0515-0390	4	3	SMM 4X0.7 6MM LG PNTX (HP 8753C AND 8702B)	28480	0515-0390
9*	0515-1114	2	6	SCREW-MACH M4 X 0.7 10MM-LG PAN-HD (HP 8753A/B AND 8702A)	28480	0515-1114
10*	3050-0893	9	5	WASHER-FL MTLC 4.0 MM 4.4-MM-ID (HP 8753A/B AND 8702A)	28480	3050-0893
11*	0515-0433	6	1	SMM 4X0.7 8MM LG PNTX	28480	0515-0433
12	0515-1110	8	1	SMM 3X0.5 12MM LG PNPD	28480	0515-1110
13	3050-0891	7	1	WASHR FL 3.0MM	28480	3050-0891
A8F1	2110-0425	0	1	FUSE 2A 125V NTD .25X.27	28480	2110-0425
A8F2	2110-0424	9	1	FUSE .75A 125V NTD .25X.27	28480	2110-0424
A8F3	2110-0425	0	1	FUSE 2A 125V NTD .25X.27	28480	2110-0425
A8F4	2110-0424	9	1	FUSE .75A 125V NTD .25X.27	28480	2110-0424
A8F5	2110-0476	1	1	FUSE 4A 125V NTD .25X.27	28480	2110-0476
A8F6	2110-0425	0	1	FUSE 2A 125V NTD .25X.27	28480	2110-0425
A8F7	2110-0476	1	1	FUSE 4A 125V NTD .25X.27	28480	2110-0476
A8F8	2110-0047	2	1	FUSE 1A 125V NTD .25X.27	28480	2110-0047
A8F9	2110-0046	1	1	FUSE .5A 125V NTD .25X.27	28480	2110-0046
MP1	08753-00039	7	1	A5 ISOLATION GROUNDING CLIP	28480	08753-00039
MP2	08753-00040	0	1	A7 ISOLATION GROUNDING SHIELD	28480	08753-00040
MP3	08753-40006	2	1	PC BOARD STABILIZER ASSEMBLY	28480	08753-40006
MP4	08753-00044	4	1	SOURCE RETAINER BRACKET (NOT SHOWN) HP 8702A/B and 8753A/B	28480	08753-00044
MP4	08753-00054	4	1	SOURCE RETAINER BRACKET (NOT SHOWN) HP 8753C AND 8702B	28480	08753-00054
MP5	08753-60072	4	1	SOURCE BRACKET/STABILIZER KIT (NOT SHOWN) HP 8702A/B AND 8753A/B	28480	08753-60072
W14				DISPLAY POWER CABLE ASSEMBLY - A8 TO A18 - SEE FIGURE 4 (HP 8753A/B AND 8702A)		

Figure 3. Top View, Attaching Hardware (2 of 2)

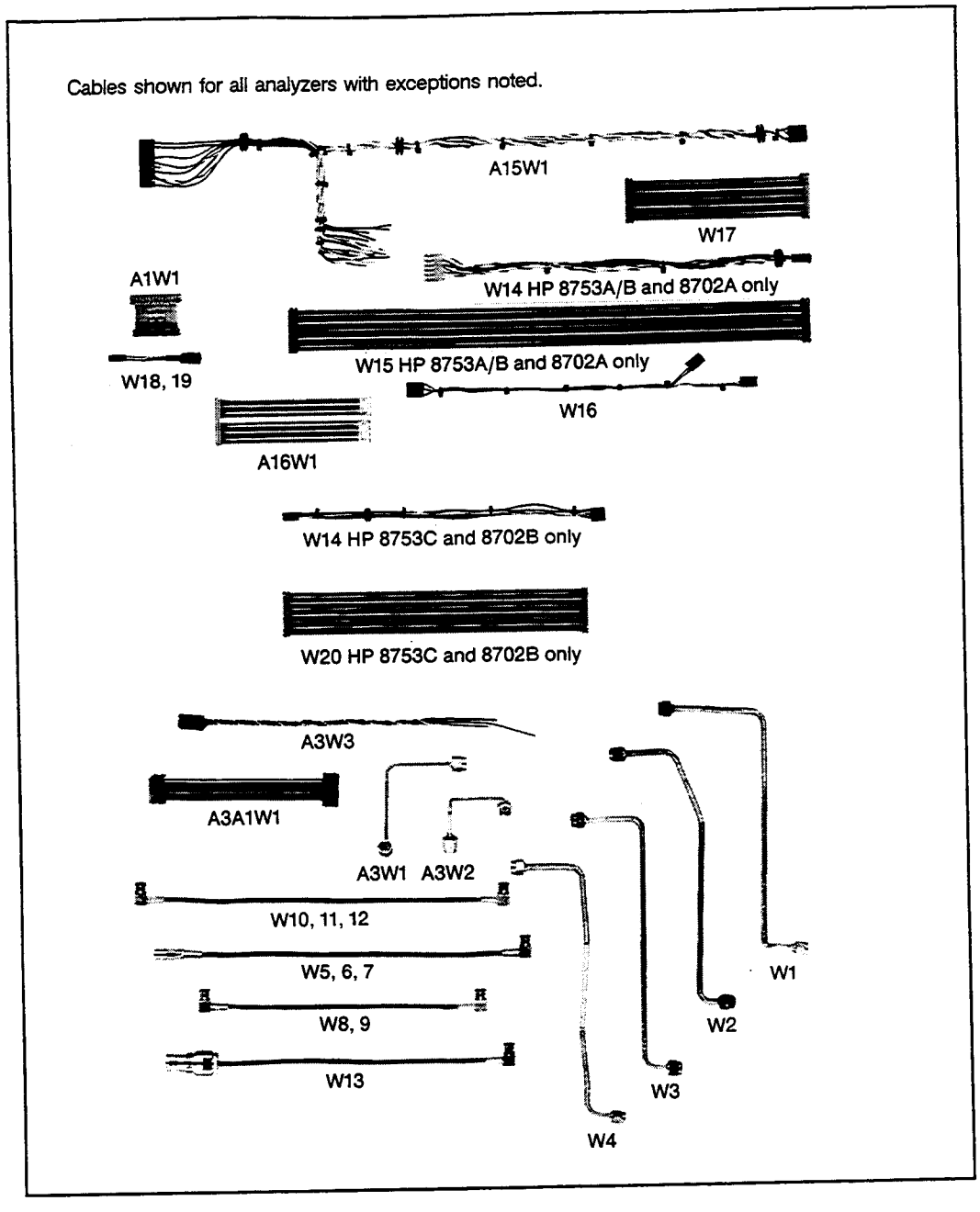
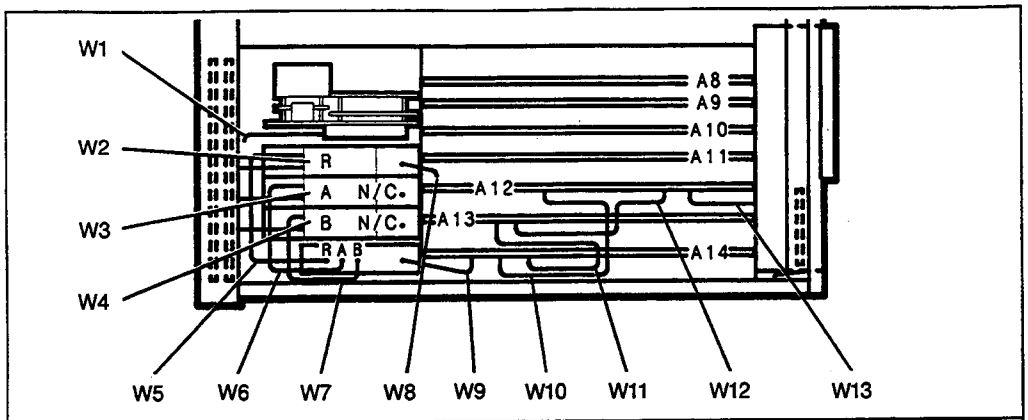


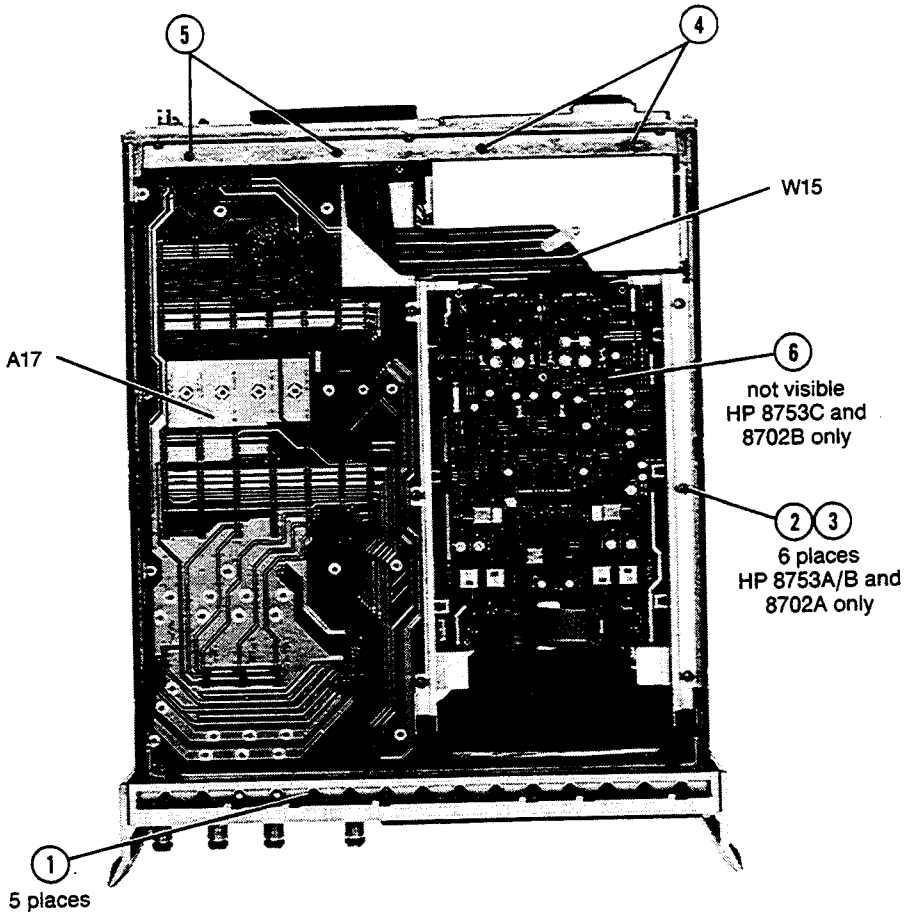
Figure 4. Cables (1 of 2)



Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1W1	**08753-60036**	**0**	**1**	**RIBBON CABLE ASSEMMBLY - A1 TO A2 (P/O A1)**	**28480**	**08753-60036**
A3A1W 1	08753-60034	8	1	RIBBON CABLE ASSY - YIG OSC. TO A3A1 (P/O A3A1)	28480	08753-60034
A3W1	08753-20031	1	1	SEMI-RIGID CABLE ASSY - YIG OSC. OUTPUT	28480	08753-20031
A3W2	08753-20032	2	1	SEMI-RIGID CABLE ASSY - CAV. OSC. OUTPUT	28480	08753-20032
A3W3	08753-60035	9	1	CABLE ASSY - CAV. OSC. TO A3A1 (P/O A3A4)	28480	08753-60035
A15W1			1	CABLE ASSY-A15 TO A8 AND A19 (HP 8753C/8702B) P/O A15		
A15W1	08753-60042	8	1	CABLE ASSY-A15 TO A8 AND A17 (P/O A15) (HP 8753A/B AND 8702A)	28480	08753-60042
A16W1	08753-60033	7	1	RIBBON CABLE ASSY - A16 TO A17 (P/O A16)	28480	08753-60033
A18W1				CABLE ASSY-A19 TO A18 (HP 8753C/8702B) P/O A18, NOT SHOWN		
W1	08753-20027	5	1	SEMI-RIGID CABLE ASSY - RF OUTPUT FROM A3	28480	08753-20027
W2	08753-20028	6	1	SEMI-RIGID CABLE ASSY - R INPUT TO A4	28480	08753-20028
W3	08753-20029	7	1	SEMI-RIGID CABLE ASSY - A INPUT TO A5	28480	08753-20029
W4	08753-20030	0	1	SEMI-RIGID CABLE ASSY - B INPUT TO A6	28480	08753-20030
W5	08753-60027	9	1	FLEXIBLE RF CABLE ASSY - A4 TO A7	28480	08753-60027
W6	08753-60027	9	1	FLEXIBLE RF CABLE ASSY - A5 TO A7	28480	08753-60027
W7	08753-60027	9	1	FLEXIBLE RF CABLE ASSY - A6 TO A7	28480	08753-60027
W8	08753-60061	1	1	FLEXIBLE RF CABLE ASSY - A4 TO A11	28480	08753-60061
W9	08753-60061	1	1	FLEXIBLE RF CABLE ASSY - A7 TO A14	28480	08753-60061
W10	08753-60029	1	1	FLEXIBLE RF CABLE ASSY - A14 TO A12	28480	08753-60029
W11	08753-60029	1	1	FLEXIBLE RF CABLE ASSY - A14 TO A13	28480	08753-60029
W12	08753-60029	1	1	FLEXIBLE RF CABLE ASSY - A13 TO A12	28480	08753-60029
W13	08753-60026	8	1	FLEXIBLE RF CABLE ASSY - A12 TO REAR PANEL	28480	08753-60026
W14	08753-60044	0	1	DISPLAY PWR CABLE ASSY - A8 TO A18 (HP 8753A/B AND 8702A)	28480	08753-60044
W14	08753-60113	4	1	DISPLAY POWER CABLE ASSY-A8 TO A19 (HP 8753C/8702B)	28480	08753-60113
W15	08753-60038	2	1	RIBBON CABLE ASSY - A17 TO A18 (HP 8753A/B AND 8702A)	28480	08753-60038
W16	08753-60041	7	1	FOCUS/INTENSITY CABLE ASSY - A17 TO A18	28480	08753-60041
W17	08753-60037	1	1	RIBBON CABLE ASSY - A2 TO A17	28480	08753-60037
W18	08753-60045	1	1	PROBE POWER CABLE ASSY - A2 TO FRONT PANEL (INCLUDES WIRES, CONNECTOR, AND JACK)	28480	08753-60045
W19	08753-60045	1	1	PROBE POWER CABLE ASSY - A2 TO FRONT PANEL (INCLUDES WIRES, CONNECTOR, AND JACK)	28480	08753-60045
W20	08753-60112	3	1	CABLE ASSY-A9 TO A19 (HP 8753C AND 8702B)	28480	08753-60112
W21	08753-60117	8		FLEXIBLE RF CABLE ASSY-R (HP 8753C AND 8702B) (FIG. 15)	28480	08753-60117
W22	08753-60118	9		FLEXIBLE RF CABLE ASSY-G (HP 8753C AND 8702B) (FIG. 15)	28480	08753-60118
W23	08753-60119	0		FLEXIBLE RF CABLE ASSY-B (HP 8753C/8702B) (FIG. 15)	28480	08753-60119

Figure 4. Cables (2 of 2)

HP 8753B shown. All analyzers can use this figure with the exceptions noted.



Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1234	7	5	SCREW-MACH M3.5 X 0.6 8MM-LG (HP 8753A/B AND 8702A)	28480	0515-1234
2*	0515-1114	2	6	SCREW-MACH M4 X 0.7 10MM-LG PAN-HD (HP 8753A/B AND 8702A)	00000	Order by Desc.
3*	3050-0893	9	6	WASHER-FL MTLC 4.0 MM 4.4-MM-ID	28480	3050-0893
4*	0515-1091	4	2	SCREW-MACHINE ASSEMBLY M3.5 X 0.6	00000	Order by Desc.
5*	0515-1232	5	2	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
6	5180-8500	8	1	INSULATOR (HP 8753C AND 8702B)	28480	5180-8500
A17				MOTHERBOARD ASSEMBLY – SEE FIGURE 2		
W15				RIBBON CABLE ASSEMBLY (HP 8753A/B AND 8702A)– A17 TO A18 – SEE FIGURE 4		

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 5. Bottom View, Attaching Hardware

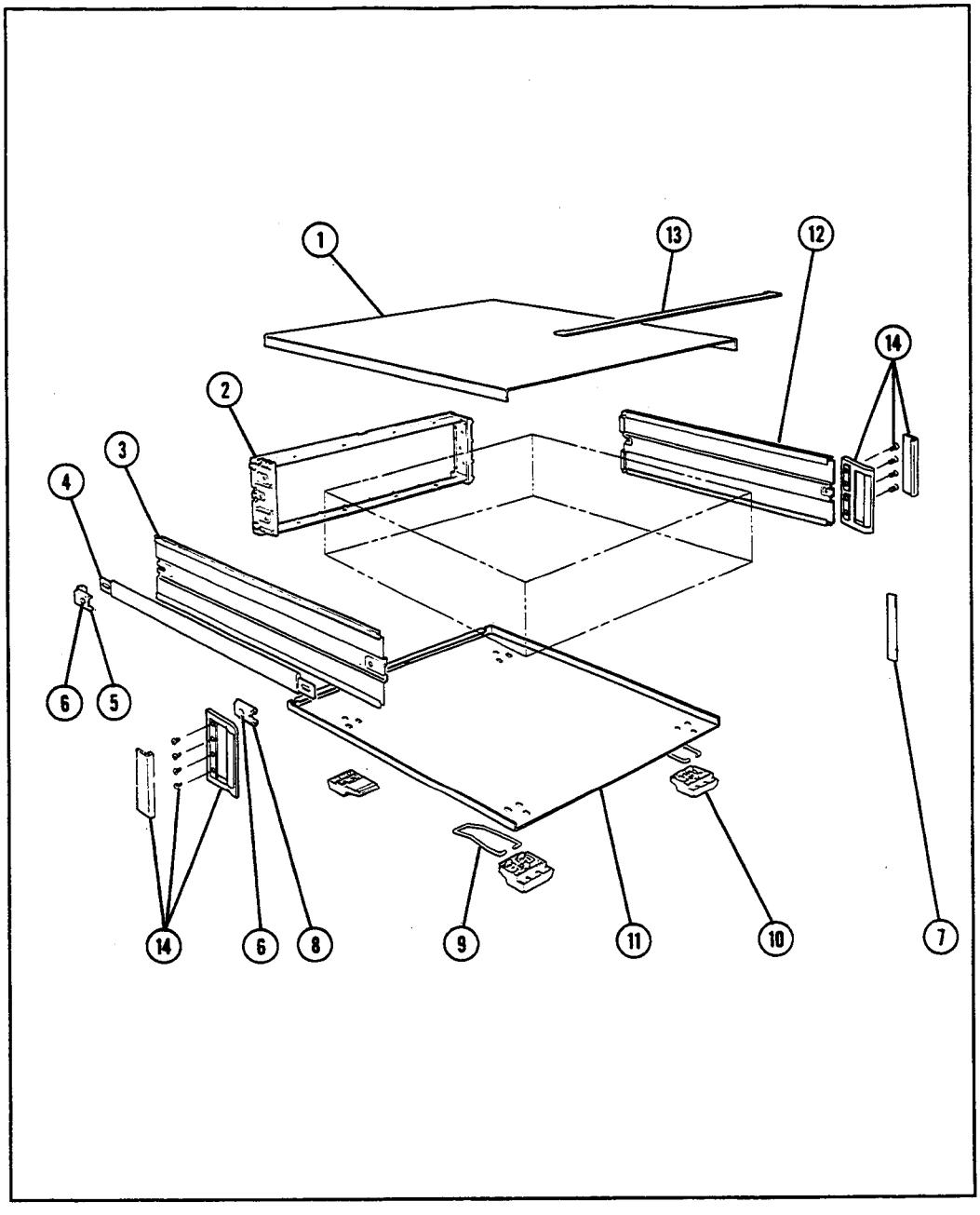
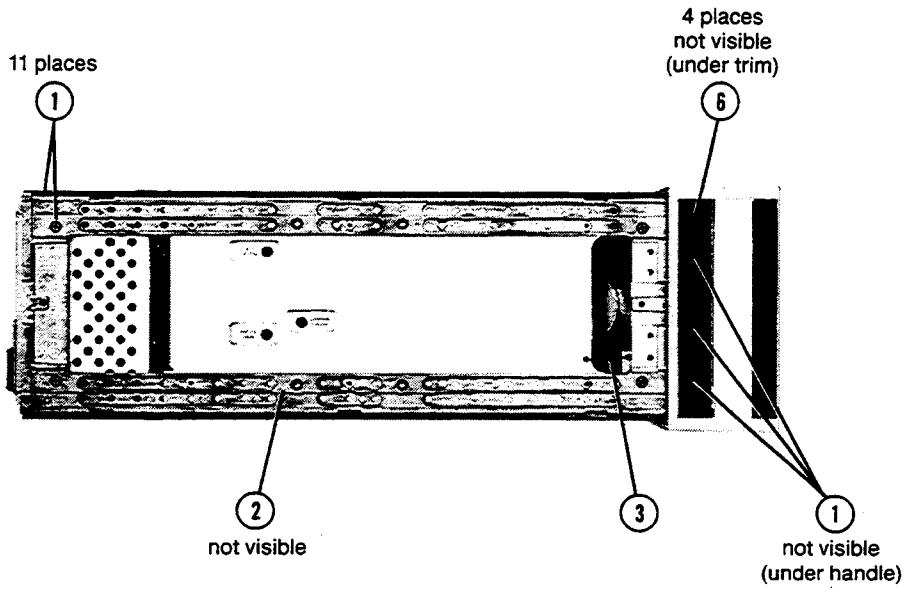


Figure 6. Chassis Parts (1 of 2)

Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
2	5021-5806	5	1	REAR FRAME	28480	5021-5806
3	5062-3842	1	1	COVER-SIDE-HANDLE	28480	5062-3842
4	5062-3704	4	1	STRAP HANDLE 18 IN.	28480	5062-3704
5	5041-8820	1	1	STRAP, HANDLE, CAP-REAR	28480	5041-8820
6*	0515-1132	4	2	SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
7	5001-0540	2	2	TRIM, SIDE (USED IF FRONT HANDLES ARE REMOVED)	28480	5001-0540
8	5041-8819	8	1	STRAP, HANDLE, CAP-FRONT	28480	5041-8819
9	1460-1345	5	2	TILT STAND SST	28480	1460-1345
10	5040-8801	8	4	FOOT (STANDARD)	28480	5040-8801
11	5062-3747	5	1	COV-BOTTOM ASSY (ORDER ITEM 11A ALSO)	28480	5061-9447
11A	08753-20039	9	1	BOTTOM COVER MYLAR INSULATOR	28480	08753-20039
12	5062-3817	0	1	COVER-SIDE-PERF	28480	5062-3817
13	5041-8802	9	1	TRIM, TOP	28480	5041-8802
14	5062-3990	0	1	FRONT HANDLE KIT (FOR RACK MOUNT OPTIONS REFER TO SYSTEM INSTALLATION IN THE OPERATING AND PROGRAMMING MANUAL)	28480	5062-3990
15	5041-8821	2	4	FOOT-REAR (NOT SHOWN)	28480	5041-8821
16	5021-8405		1	FRONT FRAME	28480	5021-8405
				NOTE:SEE TABLE 2 FOR TOUCH-UP PAINT		

HP 8753B shown. All analyzers can use this figure.

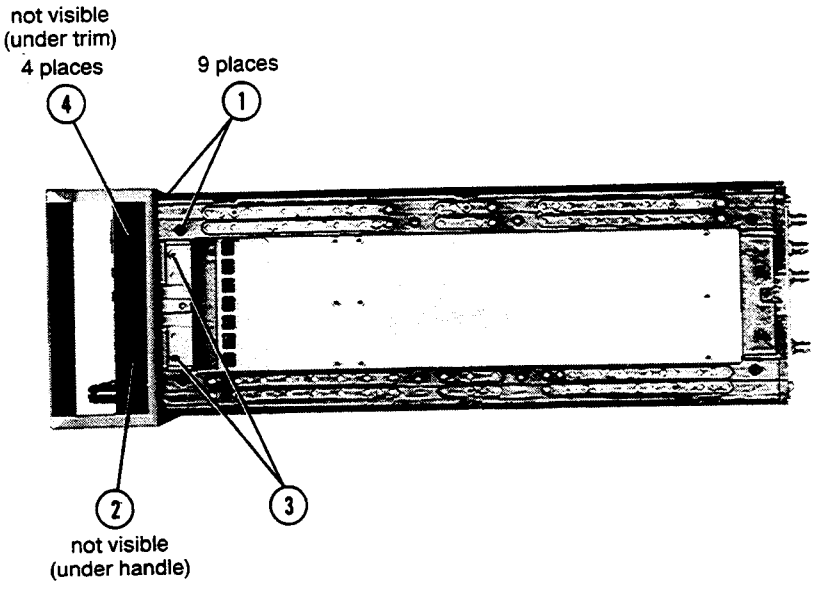


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1331	5	11	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
2*	0515-0430	3	1	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0430
3	1460-1573	1	1	SPRING-EXT .138-IN-OD SST PSVT	28480	1460-1573
4	08753-00017	1	1	LINE SWITCH ACTUATOR (NOT SHOWN) (HP 8753A/B AND 8702A)	28480	08753-00017
4	08753-00048		1	LINE SWITCH ACTUATOR (NOT SHOWN) (HP 8753A/B AND 8702A)	28480	08753-00048
5	08757-40005	9	1	LINE BUTTON (NOT SHOWN)	28480	08757-40005
6*	0515-0898	7	4	SMM 4 X 0.7 10MM - LG FLPD	28480	0515-0896

*CAUTION: This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 7. Left View, Attaching Hardware

HP 8753B shown. All analyzers can use this figure.

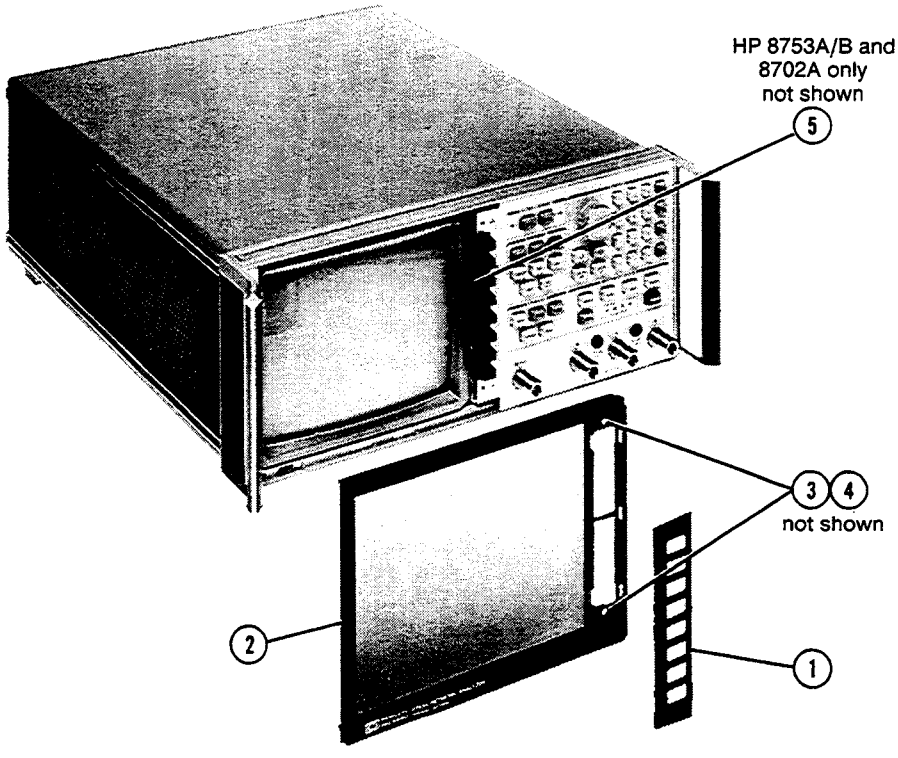


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1331	5	9	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
2*	0515-1234	7	1	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
3*	0515-1232	5	2	SMM 3.5 X 0.6 8MM LG PNPD	28480	0515-1232
4*	0515-0896	5	4	SMM 4 X 0.7 10MM - LG FLPD	28480	0515-0896

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 8. Right View, Attaching Hardware

HP 8753B shown. All analyzers can use this figure with the exceptions noted.

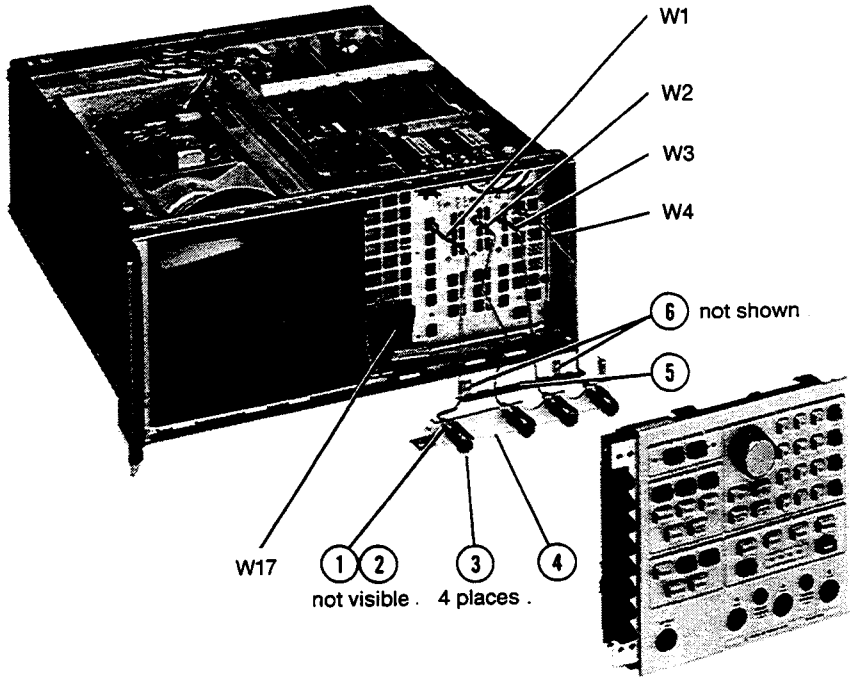


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	08753-40001	7	1	SOFTKEYS COVER (HP 8753A/B AND 8702A)	28480	08753-40001
1	08757-40012	4	1	SOFTKEYS COVER (HP 8753C/8702B)	28480	08757-40012
2	08753-60046	2	1	HP 8753A DISPLAY BEZEL ASSY (INCLUDES GLASS)	28480	08753-60046
2	08753-60080	4	1	HP 8753B DISPLAY BEZEL ASSY (INCLUDES GLASS)	28480	08753-60080
2	08702-60001	8	1	HP 8702A DISPLAY BEZEL ASSY (INCLUDES GLASS)	28480	08702-60001
2	08753-60116	7	1	HP 8753C DISPLAY BEZEL ASSY (INCLUDES GLASS)	28480	08753-60116
2	08702-60005	2	1	HP 8702B DISPLAY BEZEL ASSY (INCLUDES GLASS)	28480	08702-60005
2A	08757-40003		1	DISPLAY BEZEL SUPPORT	28480	08757-40003
3	3050-1192	3	2	WASHER-FL MTLC 3.5 MM 3.8-MM-ID	28480	3050-1192
4*	0515-1232	5	2	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
5				LABEL - PARALLAX SOFTKEY MENU - SEE FIGURE 18 (HP 8753A/B AND 8702A)		
6	8	1		DISPLAY GASKET (NOT SHOWN) (HP 8753A/B AND 8702A)	28480	08757-20034
6	5041-9104	6	1	BACK BEZEL (NOT SHOWN) (HP 8753C/8702B)	28480	5041-9104

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 9. Display, Bezel Assembly

HP 8753B shown. All analyzers can use this figure.

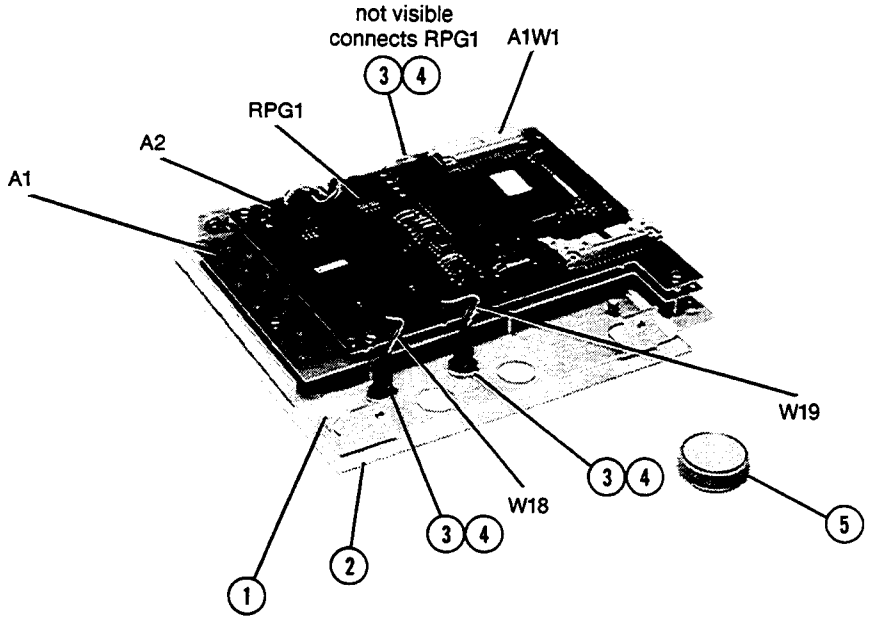


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	2190-0104	0	4	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
2	2950-0132	6	4	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	00000	Order by Desc.
3	86290-60005	7	4	TYPE-N CONNECTORS	28480	86290-60005
4	08753-00003	5	1	TYPE-N CONNECTOR BRACKET	28480	08753-00003
5	08753-00021	7	1	CABLE SUPPORT BRACKET	28480	08753-00021
6*	0515-0886	3	2	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0886
W1				SEMI-RIGID CABLE ASSEMBLY - RF OUTPUT FROM A3 - SEE FIGURE 4		
W2				SEMI-RIGID CABLE ASSEMBLY - R INPUT TO A4 - SEE FIGURE 4		
W3				SEMI-RIGID CABLE ASSEMBLY - A INPUT TO A5 - SEE FIGURE 4		
W4				SEMI-RIGID CABLE ASSEMBLY - B INPUT TO A6 - SEE FIGURE 4		
W17				RIBBON CABLE ASSEMBLY - A2 TO A17 - SEE FIGURE 4		

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 10. Front Panel, RF Cables

HP 8753B shown. All analyzers can use this figure.

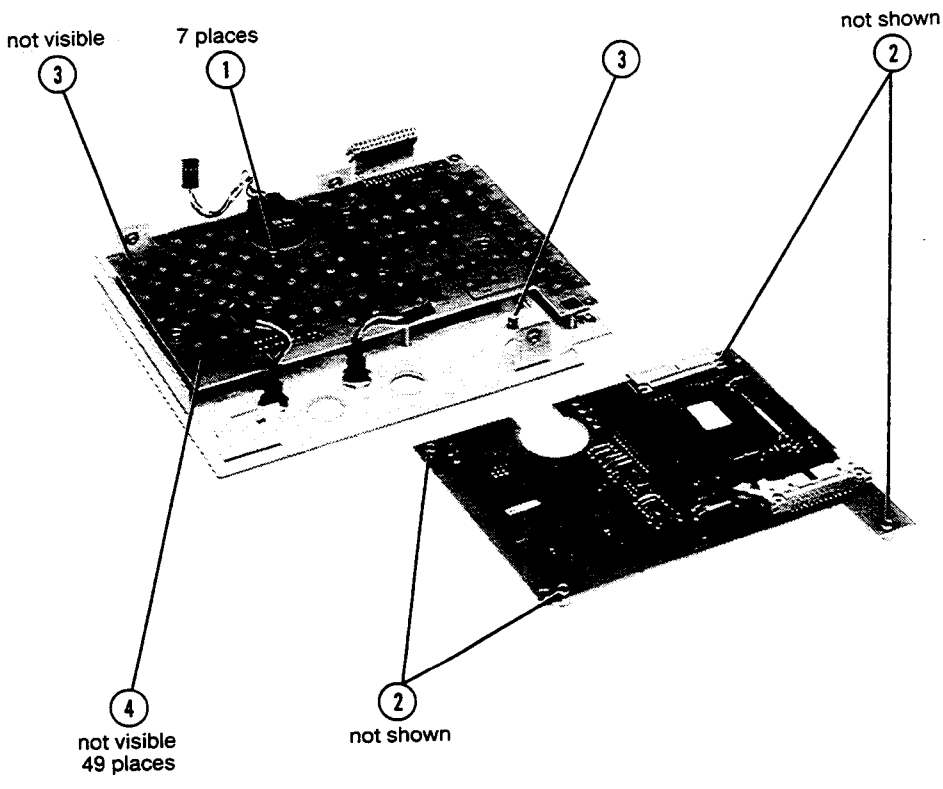


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	08753-00002	4	1	FRONT SUB-PANEL	28480	08753-00002
2	08753-00001	3	1	FRONT DRESS PANEL	28480	08753-00001
3	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
4	2950-0043	8	3	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	Orderby Desc.
5	0370-2992	8	1	KNOB-BASE 1-1/8 JGK .252-IN-ID	28480	0370-2992
A1				FRONT PANEL KEYBOARD ASSEMBLY - SEE FIGURE 2		
A1W1				RIBBON CABLE ASSEMBLY - A1 TO A2 - SEE FIGURE 4		
A2				FRONT PANEL INTERFACE BOARD ASSEMBLY - SEE FIGURE 2		
RPG1	08757-60053	5	1	ROTARY PULSE GENERATOR (RPG)	28480	08757-60053
W18				PROBE POWER CABLE ASSEMBLY - A2 TO FRONT PANEL - SEE FIGURE 4		
W19				PROBE POWER CABLE ASSEMBLY - A2 TO FRONT PANEL - SEE FIGURE 4		

*CAUTION: This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 11. Front Panel, Assemblies

HP 8753B shown. All analyzers can use this figure.

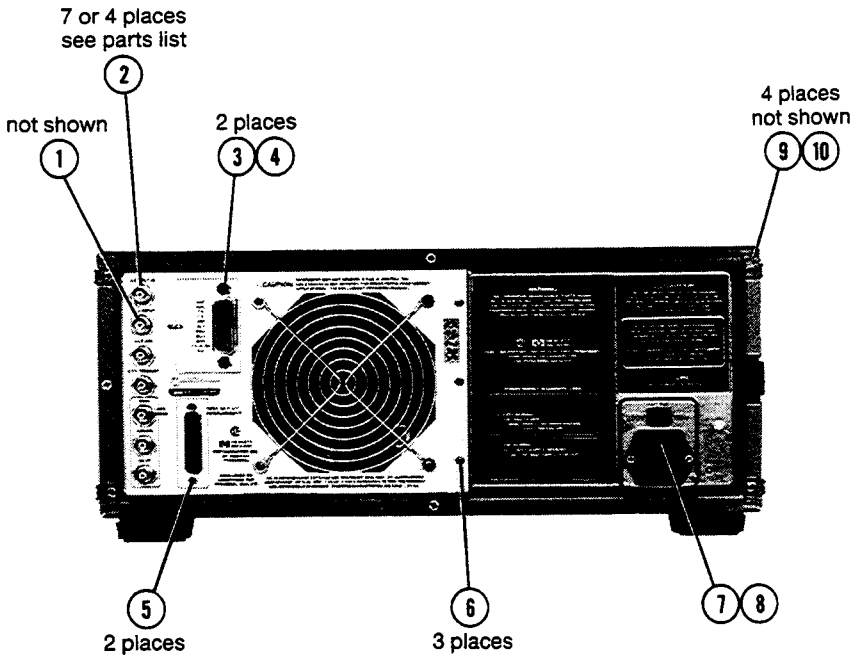


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-0897	6	7	SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
2*	0515-1112	0	4	SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	28480	0515-1112
3	0510-1148	2	2	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
4	5060-9436	7	49	SWITCH-PB SPST-NO MOM .1A 5 VDC	28480	5060-9436

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 12. Front Panel, Attaching Hardware

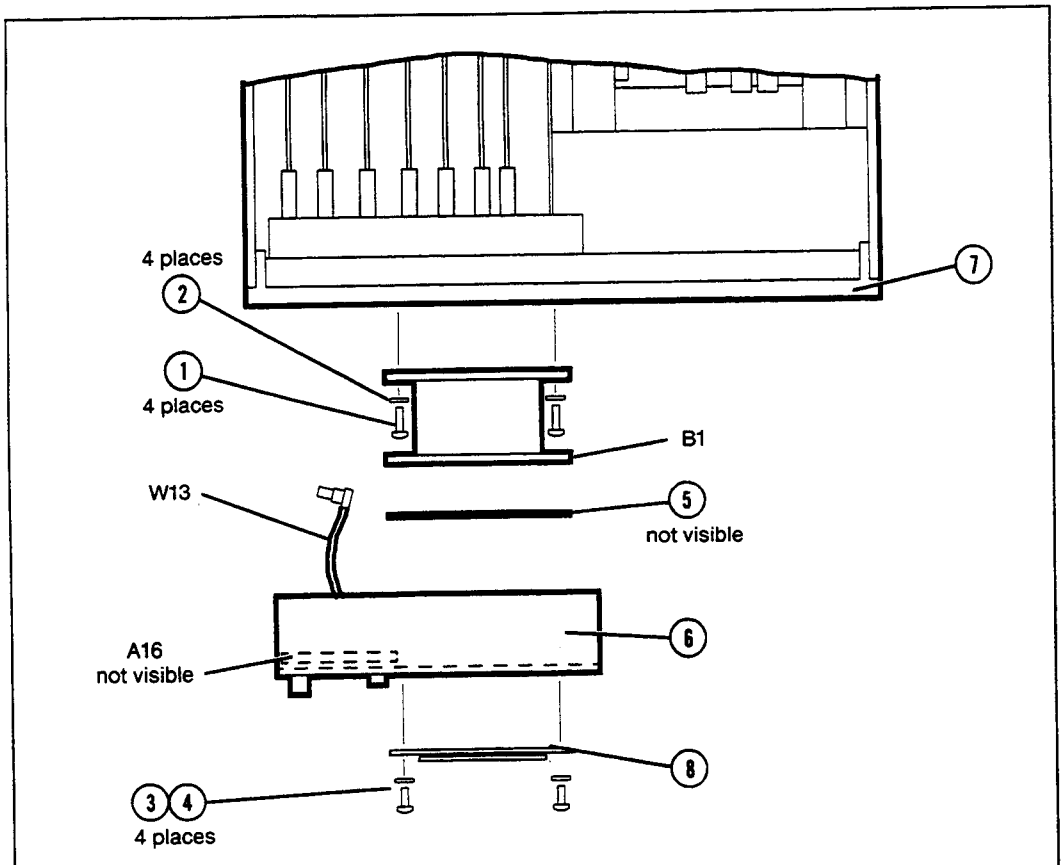
HP 8753C shown. All analyzers can use this figure with the exceptions noted.



Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	2190-0102	8	7	WASHER-LK INTLT 15/32 IN. 472-IN-ID (HP 8753C/8702B)	28480	2190-0102
1	2190-0102	8	4	WASHER-LK INTL T 15/32 IN .472-IN-ID (HP 8753A/B AND 8702A)	28480	2190-0102
2	2950-0035	8	7	NUT-HEX-DBL-CHAM 15/32-32-THD (HP 8753C/8702B)	00000	Orderby Desc.
2	2950-0035	8	4	NUT-HEX-DBL-CHAM 15/32-32-THD (HP 8753A/B AND 8702A)	00000	Orderby Desc.
3	2190-0586	2	2	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
4	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32THD	00000	Orderby Desc.
5	1251-2942	7	2	LOCK-SUBMIN D CONN (INCLUDES LOCKWASHERS)	28480	1251-2942
6*	0515-0886	3	3	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0886
7	9135-0265	5	1	FILTER-LINE OPERATING VOLTAGE:250 V MAX	06324	FN 365-4/05
8	2110-0780	0	0	FUSE 3A 250V F (LISTED FOR REPLACEMENT PURPOSES. TWO ARE INCLUDED IN ITEM 7.	2805	GMA-3
9	5040-7221	2	4	FOOT, REAR	28480	5040-7221
10	0515-1232	5	4	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 13. Rear Panel, Attaching Hardware

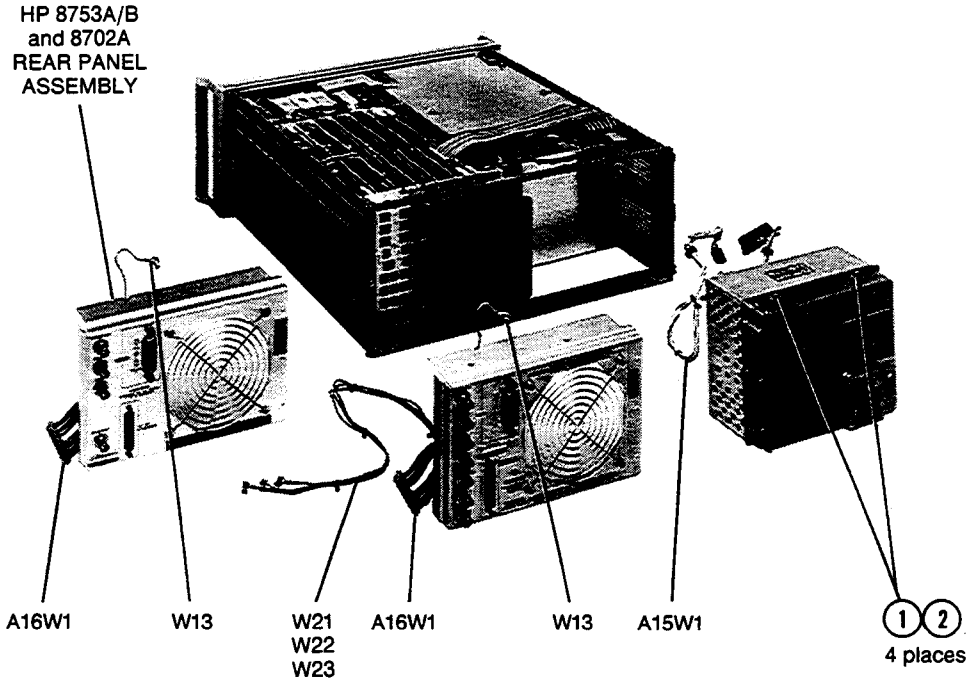


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-0965	9	4	SCREW-SKT-HD-CAP M3 X 0.5 14MM-LG	28480	0515-0965
2	2190-0584	0	4	WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
3*	0515-0887	4	4	SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	28480	0515-0887
4	3050-1192	3	4	WASHER-FL MTLC .406-IN-ID 1.5 IN-ID-STL	28480	3050-1192
5	08753-20040	2	1	FAN GASKET	28480	08753-20040
6	08753-00019	3	1	REAR PANEL (HP 8753A/B AND 8702A)	28480	08753-00019
6	08753-00047	7	1	REAR PANEL (HP 8753C/8702B)	28480	08753-00047
7				REAR FRAME - SEE FIGURE 6		
8	3160-0281	2	1	FAN GRILLE	28480	3160-0281
A16	08753-60016	6	1	REAR PANEL BOARD ASSY (INCLUDES A16W1) (HP 8753A/B AND 8702A)	28480	08753-60016
A16	08753-60094	0	1	REAR PANEL BOARD ASSY (INCLUDES A16W1) (HP 8753C/8702B)	28480	08753-60094
B1	08753-60047	3	1	FAN (INCLUDES CABLE ASSY)	28480	08753-60047
W13				FIGURE 4		
				NOTE:Refer to the Instrument History section for previous history information.		

*CAUTION: This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 14. Rear Panel, Assemblies

HP 8753C shown with additional rear panel assembly for HP 8753A/B and 8702A.All analyzers can use this figure.

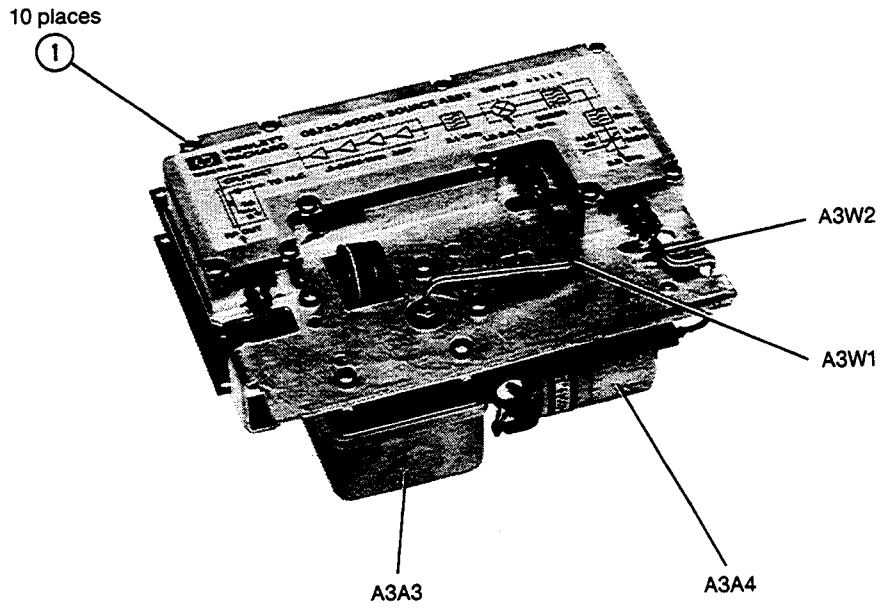


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-0443	8	4	SCREW-MACH M4 X 0.7 20MM-LG PAN-HD	28480	0515-0443
2	2190-0586	2	4	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
A15W1				CABLE ASSEMBLY - A15 TO A8 AND A17 - SEE FIGURE 4		
A16W1				RIBBON CABLE ASSEMBLY - A16 TO A17 - SEE FIGURE 4		
W13				FLEXIBLE RF CABLE ASSEMBLY - A12 TO REAR PANEL SEE FIGURE 4		
W21			1	FLEXIBLE RF CABLE ASSY - R - SEE FIGURE 4		
W22			1	FLEXIBLE RF CABLE ASSY - G - SEE FIGURE 4		
W23			1	FLEXIBLE RF CABLE ASSY - B - SEE FIGURE 4		

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 15. Rear Panel, Cables

HP 8753B shown. All analyzers can use this figure.

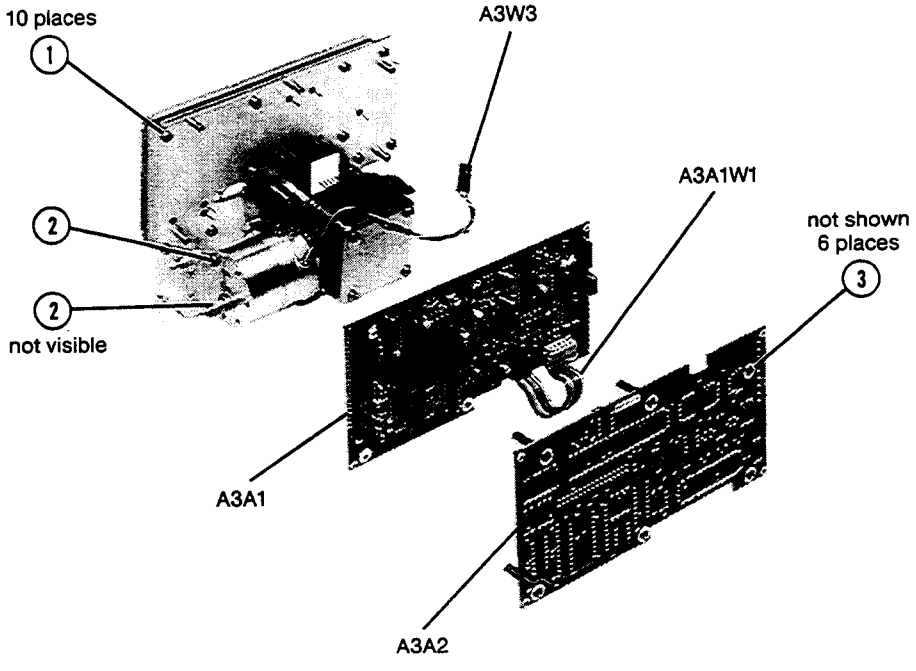


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-0897	6	10	SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
A3A3				YIG OSCILLATOR - PART OF A3 - SEE FIGURE 2		
A3A4				CAVITY OSCILLATOR - PART OF A3 - SEE FIGURE 2		
A3W1				SEMI-RIGID CABLE ASSEMBLY - YIG OSC. OUTPUT SEE FIGURE 4		
A3W2				SEMI-RIGID CABLE ASSEMBLY - CAV. OSC. OUTPUT SEE FIGURE 4		

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 16. A3 Source Assembly

HP 8753B shown. All analyzers can use this figure.

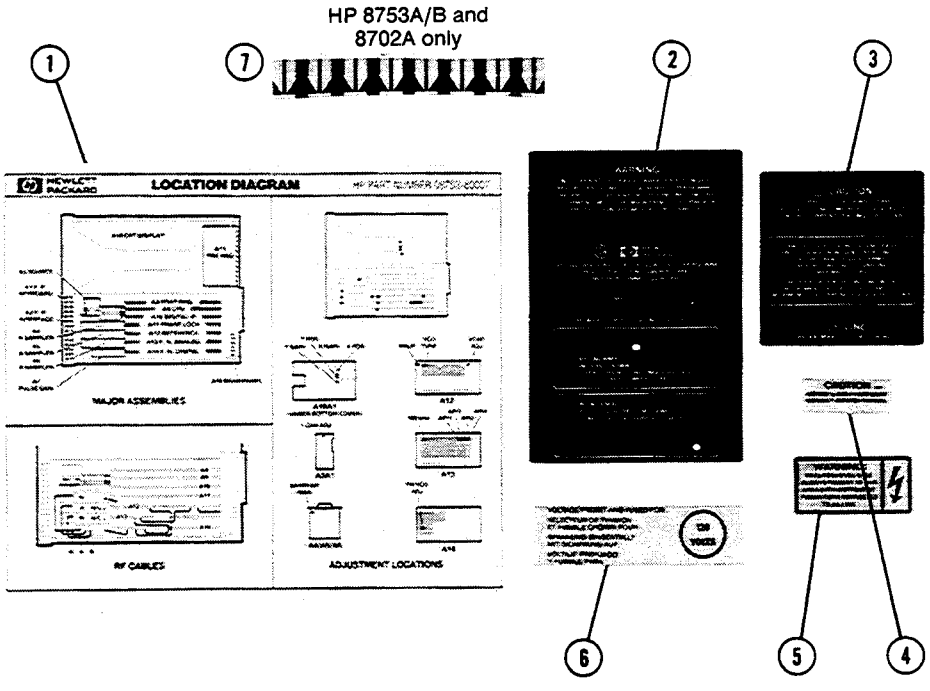


Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-0897	6	10	SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
2	2360-0113	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	Order by Desc.
3*	0515-1323	5	6	SCREW-MACH M3 X 0.5 30MM-LG PAN-HD	28480	0515-1323
A3A1				SOURCE BIAS BOARD - PART OF A3 - SEE FIGURE 2		
A3A1W1				RIBBON CABLE ASSEMBLY - YIG OSC. TO A3A1 - SEE FIGURE 4		
A3A2				ALC BOARD - PART OF A3 - SEE FIGURE 2		
A3W3				CABLE ASSEMBLY - CAV. OSC. TO A3A1 - SEE FIGURE 4		

***CAUTION:** This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 17. A3 Source Assembly, Detail

HP 8753B labels shown. All analyzers can use this figure with the exceptions noted.



Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	08753-80007	7	1	LABEL - LOCATION DIAGRAM (HP 8753A/B AND 8702A)	28480	08753-80007
1	08753-80074	8	1	LABEL - LOCATION DIAGRAM (HP 8753C/8702B)	28480	08753-80074
2	08753-80002	2	1	LABEL - LED OPERATION WARNING (HP 8753A/B AND 8702A)	28480	08753-80002
2	08753-80075	9	1	LABEL - LED OPERATION WARNING (HP 8753C/8702B)	28480	08753-80075
3	08753-80001	1	1	LABEL - CAUTION FUSE RATING (HP 8753A/B AND 8702A)	28480	08753-80001
3	08753-80080	6	1	LABEL - CAUTION FUSE RATING (HP 8753C/8702B)	28480	08753-80080
4	7121-2527	5	1	LABEL - METRIC HARDWARE CAUTION	28480	7121-2527
5	7120-4295	6	1	LABEL - HAZARDOUS VOLTAGE WARNING	28480	7120-4295
6	7120-6999	1	1	LABEL - LINE VOLTAGE SELECTOR SWITCH	28480	7120-6999
7	08753-80005	5	1	LABEL - PARALLAX SOFTKEY MENU (HP 8753A/B AND 8702A)	28480	08753-80005
8	08702-80002	1		LABEL _ IN 100W	28480	08702-80002
9	08753-80057	7		LABEL _ IN 102W	28480	08753-80057
10	08753-80066	8		LABEL - WARNING CAUTION	28480	08753-80066
11	7121-5125	5		TAG - WARNING ESD SENSITIVE	28480	7121-5125

*CAUTION: This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 18. Replaceable Labels

Table 2. Miscellaneous Replaceable Accessories (1 of 2)

Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				SERVICE TOOLS		
	08753-60023	5		HP 8753 AND 8702 TOOL KIT	28480	08753-60023
				SOFTWARE		
	08753-10012	7		HP 8753A/B/C 8702A/B PERF TESTS/ADJ SOFTWARE	28480	08753-10012
	08753-10001	4		HP 8753A EXAMPLE MEASUREMENT PROGRAM	28480	08753-10001
	08753-10011	6		HP 8753B EXAMPLE MEASUREMENT PROGRAM	28480	08753-10011
	08702-10001	3		HP 8702A EXAMPLE MEASUREMENT PROGRAM	28480	08702-10001
	08753-10014	9		HP 8753C EXAMPLE MEASUREMENT PROGRAM	28480	08753-10014
				DOCUMENTATION		
	08702-10002	4		HP 8702B EXAMPLE MEASUREMENT PROGRAM	28480	08702-10002
	08753-90001	2		HP 8753A OPERATING AND PROGRAMMING MANUAL	28480	08753-90001
	08753-90021	6		HP 8753A TEST SETS AND ACCESSORIES MANUAL BINDER	28480	08753-90021
	08753-90136	4		HP 8753B OPERATING AND SERVICE MANUAL SET	28480	08753-90136
	08753-90138	6		HP 8753B OPERATING MANUAL REPLACEMENT KIT	28480	08753-90138
	08702-90002	2		HP 8702A OPERATING AND PROGRAMMING MANUAL	28480	08702-90002
	08753-90153	5		HP 8753C OPERATING AND SERVICE MANUAL SET	28480	08753-90153
	08753-90155	7		HP 8753C OPERATING AND PROGRAMMING MANUAL	28480	08753-90155
	08753-90156	8		HP 8753A/B/C AND 8702A/B SERVICE MANUAL	28480	08753-90156
	08702-90001	1		HP 8702B OPERATING AND SERVICE MANUAL SET	28480	08702-90001
	85043-90009	8		HP 85043B SYSTEM RACK MANUAL	28480	85043-90009
	85046-90001	8		HP 85046A/B S-PARAMETER TEST SETS MANUAL	28480	85046-90001
	85044-90001	6		HP 85044A/B TRANSMISSION/REFLECTION TEST SETS MANUAL	28480	85044-90001
	85047-90001	9		HP 85047A S-PARAMETER TEST SET MANUAL	28480	85047-90001
	85031-90003	3		HP 85031B 7 MM CALIBRATION KIT MANUAL	28480	85031-90003
	85032-90007	8		HP 85032B 50 OHM TYPE-N CALIBRATION KIT MANUAL	28480	85032-90007
	85033-90007	9		HP 85033C 3.5 MM CALIBRATION KIT MANUAL	28480	85033-90007
	85036-90003	8		HP 85036B 75 OHM TYPE-N CALIBRATION KIT MANUAL	28480	85036-90003
	85029-90001	7		HP 85029A 7 MM VERIFICATION KIT MANUAL	28480	85029-90001
	85029-90010	8		HP 85029B 7 MM VERIFICATION KIT MANUAL	28480	85029-90010
	11851-90007	4		HP 11851B 50 OHM TYPE-N RF CABLE KIT MANUAL	28480	11851-90007
	11857-90014	9		HP 11857D 7 MM TEST PORT EXTENSION CABLES MANUAL	28480	11857-90014
	11857-90016	1		HP 11857B 75 OHM TYPE-N TEST PORT CABLES MANUAL	28480	11857-90016
	11850-90019	7		HP 11850C 50 OHM 3-WAY POWER SPLITTER MANUAL	28480	11850-90019
	11850-90021	1		HP 11850D 75 OHM 3-WAY POWER SPLITTER MANUAL	28480	11850-90021
	11667-90003	6		HP 11667A POWER SPLITTER MANUAL	28480	11667-90003
	11852-90009	7		HP 11852B 50 to 75 OHM MINIMUM LOSS PAD MANUAL	28480	11852-90009
	85033-90010	4		HP 85033A SMA CALIBRATION KIT MANUAL	28480	85033-90010
	11600-90006	0		HP 11600B TRANSISTOR FIXTURE MANUAL	28480	11600-90006
	11608-90029	5		HP 11608A TRANSISTOR FIXTURE MANUAL	28480	11608-90029
	01349-90901	7		HP1349A/D DISPLAY MANUAL	28480	01349-90901
	11858-90001	5		HP 11858A TRANSISTOR FIXTURE ADAPTER MANUAL	28480	11858-90001
	08510-90064	4		HP MICROWAVE CONNECTOR CARE MANUAL	28480	08510-90064
	5954-1566	3		HP MICROWAVE CONNECTOR CARE APPLICATION NOTE	28480	5954-1566
	85024-90001	2		HP 85024A RF PROBE O/S MANUAL	28480	85024-90001
	08347-90001	0		HP 8347A RF AMPLIFIER O/S MANUAL	28480	08347-90001
	11853-90003	2		HP 11853A 50 OHM ACCESSORY KIT MANUAL	28480	11853-90003
	11854-90001	1		HP 11854A 50 OHM ACCESSORY KIT MANUAL	28480	11854-90001
	11855-90001	2		HP 11855A 75 OHM ACCESSORY KIT MANUAL	28480	11855-90001
	11856-90001	3		HP 11856A 75 OHM ACCESSORY KIT MANUAL	28480	11856-90001
	83400-90001	4		HP 83400A/1A LIGHTWAVE SOURCE MANUAL	28480	83400-90001
	83410-90001	6		HP 83410A LIGHTWAVE RECEIVER MANUAL	28480	83410-90001
	11890-90001	5		HP 11890A/1A LIGHTWAVE COUPLER MANUAL	28480	11890-90001
	11889-90001	2		HP 11889A RF INTERFACE KIT MANUAL	28480	11889-90001
	11886-90001	9		HP 11886A/7A INTERCONNECT CABLE KIT MANUAL	28480	11886-90001
	8753B-02			FIRMWARE REVISION 2.01 SERVICE NOTE	28480	8753B-02

*To obtain a listed service note, contact your local Hewlett-Packard Service Center.

Table 2. Miscellaneous Replaceable Accessories (2 of 2)

Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				UPGRADE KITS		
	11882A	7		HP 8753B UPGRADE KIT (HP 8753A to HP 8753B)	28480	11882A
	11883A	8		HARMONIC MEASUREMENT UPGRADE KIT (HP 8753B/C to HP 8753B/C Opt.002)	28480	11883A
	11884A	9		6 GHz RECEIVER UPGRADE KIT (HP 8753B/C to HP 8753B/C Option 006)	28480	11884A
	11876A	1		HP 8702A UPGRADE KIT (HP 8753A to HP 8702A)	28480	11876A
	85019A	7		TIME DOMAIN UPGRADE KIT HP 8753A (HP 8753A to HP 8753A Option 010)	28480	85019A
	85019B	9		TIME DOMAIN UPGRADE KIT HP 8753B (HP 8753B/C to HP 8753B/C Option 010)	28480	85019A
				SERVICE TOOLS		
				SERVICE NOTES*		
	8753A-1A			A9 EEPROM BACKUP	28480	8753A-1A
	8753A-5			IMPROVING RELIABILITY OF THE A3 SOURCE ASSEMBLY	28480	8753A-5
	8753A-6			INSTRUCTIONS FOR INSTALLING CRT BEZEL GASKET	28480	8753A-6
	8753A-7B			A3 SOURCE/A9 CPU A11 PHASELOCK COMPATIBILITY	28480	8753A-7B
	8753A-8A			INSTRUCTIONS FOR INSTALLING NEW FIRMWARE	28480	8753A-8A
	8753A-9			PERFORMANCE TEST SOFTWARE REVISION A.01	28480	8753A-9
	8753A-10			WORKAROUNDS FOR HP 8753A REV. 1.00 FIRMWARE ANOMALIES	28480	8753A-10
	8753A-11A			FAN ASSEMBLY UPGRADE KIT	28480	8753A-11A
	8753B-01			DISPLAY FLICKER PROBLEM	28480	8753B-01
	8753C-01			FIRMWARE REVISION 4.00 PROBLEMS	28480	8753C-01
	08753-90169			HP 8753A/B SCHEMATIC PACKAGE	28480	08753-90169
				HP-IB CABLES		
	18033A			HP-IB CABLE, 1M (3.3 FT)	28480	18033A
	18033B			HP-IB CABLE, 2M (6.6 FT)	28480	18033B
	18033C			HP-IB CABLE, 4M (13.2 FT)	28480	18033C
	18033D			HP-IB CABLE, 0.5M (1.6 FT)	28480	18033D
				TOUCH-UP PAINT		
	6010-1146	6		DOVE GRAY PAINT FOR USE ON FRAME AROUND FRONT PANEL AND PAINTED PORTION OF HANDLES	28480	6010-1146
	6010-1147	7		FRENCH GRAY PAINT FOR USE ON SIDE, TOP, AND BOTTOM COVERS	28480	6010-1147
	6010-1148	8		PARCHMENT GRAY PAINT FOR USE ON RACK MOUNT FLANGES, RACK SUPPORT FLANGES, AND FRONT PANELS	28480	6010-1148
				OTHER		
				FUSE – SEE FIGURE 13		

*To obtain a listed service note, contact your local Hewlett-Packard Service Center.

REPAIR SEQUENCE

Troubleshooting: identify the faulty assembly
Replacement Procedures: how to remove the old part, install the new
Replaceable Parts: how to order a replacement part
Post-Repair Procedures: what to adjust and how to verify
Adjustments: how to adjust the replacement assembly

INTRODUCTION

This section contains procedures for removing the following assemblies from the analyzer:

A1/A2 front panel
A3 source
A16/A15 rear panel/preregulator
A18 display

A1/A2 Front Panel Replacement

TOOLS REQUIRED

Small Pozidriv screwdriver
Very small flat edge screwdriver
ESD grounding wrist strap

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 1. The analyzer illustrated is an HP 8753B, but the instructions apply to all models.

To Disassemble

1. Remove the bezel's softkey cover (item 1) by sliding your fingernail under the left edge, near the top or bottom of the cover. Pry the softkey cover away from the bezel. If you use another tool, take care not to scratch the glass.
2. Remove the two screws and washers (item 2) exposed by the previous step. The bezel (item 3) is now free from the frame. Remove it.
3. Remove the trim strip from the top edge of the front frame by prying under the strip with a flat screwdriver.
4. Remove the two screws from the top edge of the frame (item 4).
5. Turn the instrument over and remove the trim strip from the bottom edge of the frame.
6. Remove the two screws from the bottom edge of the frame (item 5).
7. Slide the front panel over the type-N connectors. Disconnect the ribbon cable (item 6) from the front panel by pressing down and out on the connector locks. The front panel is now free of the instrument.

To Remove the A2 Front Panel Processor Assembly

8. Remove the two probe power cables (item 7) and the RPG cable (item 8).
9. Remove the four screws in the corners of the A2 assembly (item 9).
10. Insert the blade of a small flat screwdriver into the slots on the sides of the ribbon cable connector (item 10). Gently pry upward on either side of the connector until it is loose.

To Remove the A1 Front Panel Keyboard

11. Remove the remaining seven screws from the A1 assembly (item 11).

To Reassemble

12. Reverse steps 1 through 11 to reassemble the front panel. Note: when installing the A1 keyboard assembly, place seven screws in the holes plated with a circular pattern. (The other four holes secure the A2 assembly.)

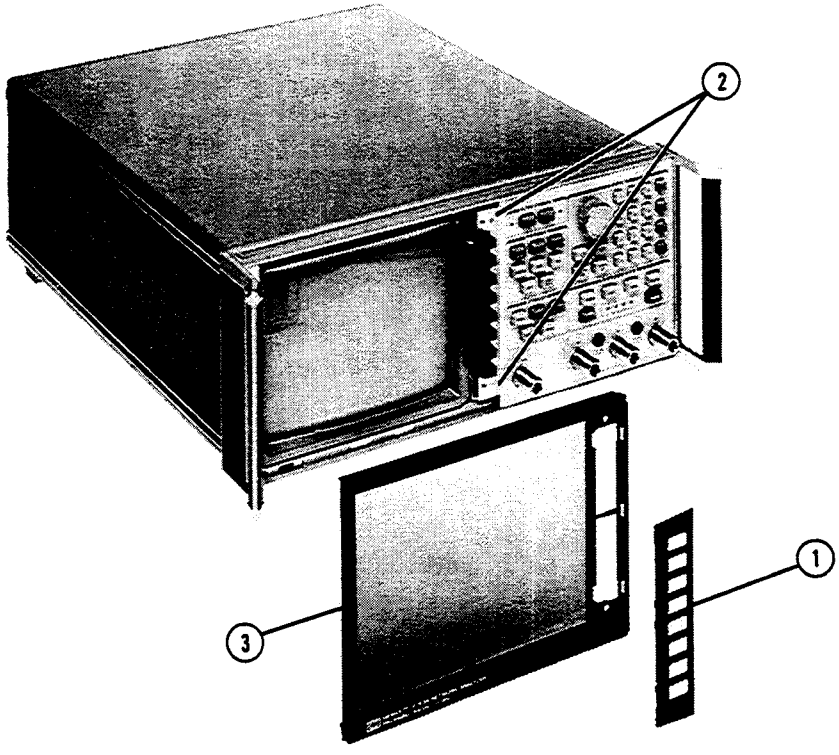


Figure 1. Front Panel Replacement (1 of 4)

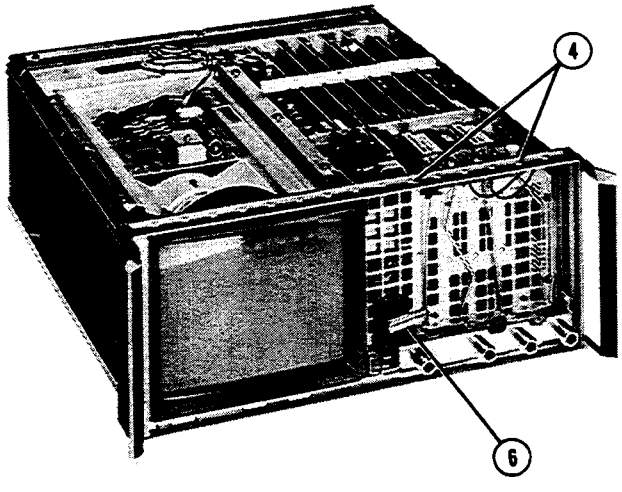


Figure 1. Front Panel Replacement (2 of 4)

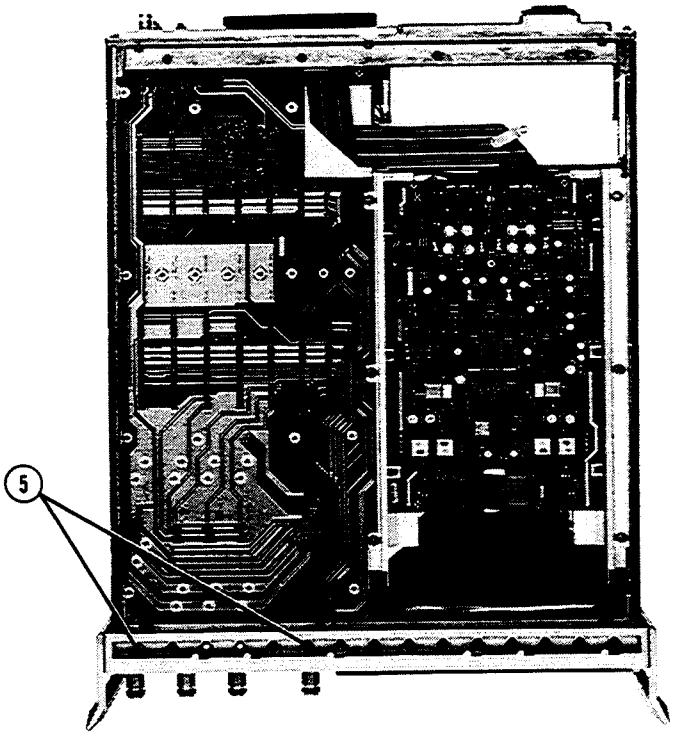


Figure 1. Front Panel Replacement (3 of 4)

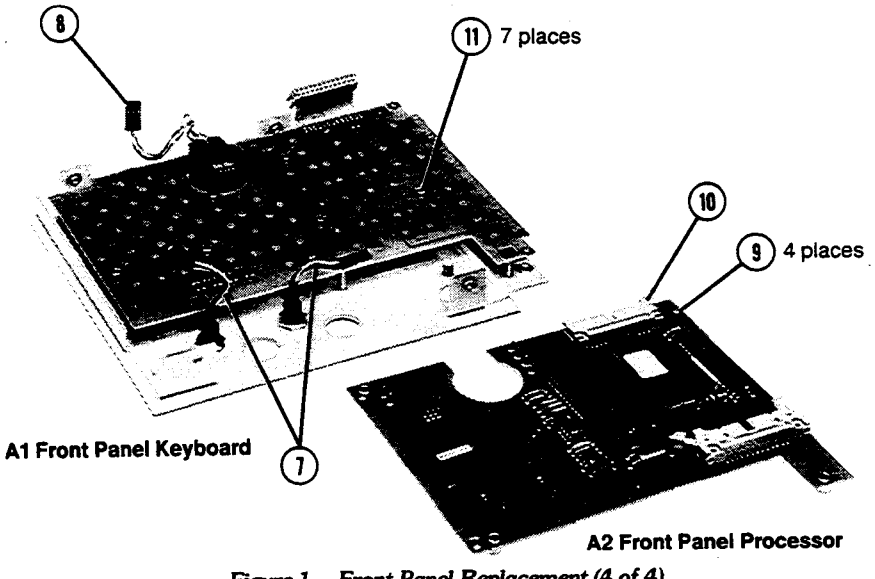


Figure 1. Front Panel Replacement (4 of 4)

A3 Source Replacement

TOOLS REQUIRED

5/16" wrench
ESD grounding wrist strap

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 2.

CAUTION

SUSCEPTIBLE TO DAMAGE FROM ESD.

Perform these procedures only at a static-safe workstation and wear a grounding strap.

To Disassemble

1. Remove the power cord and the top cover.
2. Remove the two screws, the washer, and the source retainer bracket (not shown) that covers the source module. Pull the two retention clips (item 1) at the front and rear of the source module to an upright position.
3. Remove the semi-rigid cable (item 2) from the source.
4. The source is seated in a motherboard edge connector. Hold the loose semi-rigid cable to the right and pull up on the source bracket handle (item 3).

To Reassemble

5. Slide the edges of the sheet metal partition (item 4) into the guides at the front and back of the source compartment. Press down on the module to ensure that it is well seated in the motherboard connector.
6. Push down the retention clips. Secure the semi-rigid cable to the source microcircuit package.
7. Replace the source retainer bracket and install the washer (slotted hole) and the two screws.

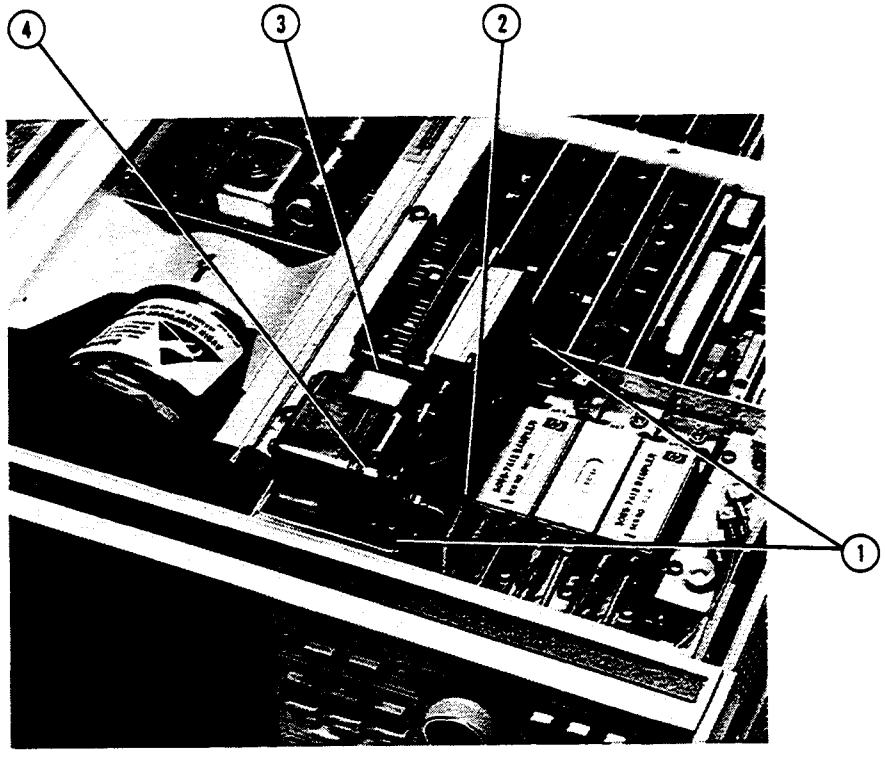


Figure 2. Source Replacement

A16 Rear Panel/A15 Preregulator Replacement

TOOLS REQUIRED

Pozidriv screwdriver
3 wrenches: 9/32"
3/16"
9/16"
ESD grounding wriststrap

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 3. The analyzer illustrated is an HP 8753B, but the instructions apply to all models.

To Disassemble

1. Remove the top and bottom covers.
2. Remove four screws, two from the top and two from the bottom frames (item 1).
3. Remove the screw from the pc board stabilizer (not shown) and remove the stabilizer.
4. Lift the A12 reference assembly from its motherboard connector and disconnect the EXT REF cable (item 2) from A12J3.
5. Remove the three screws on the left of the fan connected to the preregulator.
6. Pull the rear panel away from the frame. Disconnect the ribbon cable from its motherboard connector by pressing down and out on the connector locks. The rear panel is now connected only by cables W21, W22, and W23 in the HP 8753C and 8702B. The rear panel is completely free in all other analyzers. To remove W21, W22, and W23, lift the A19 assembly from the card cage by gently pressing the top of the board toward the A18 display, then lift up. Disconnect the cables at the SMB connectors on the A19.
7. Now perform step 5a or 5b, depending on the assembly to be removed.

To Remove the A16 Rear Panel Assembly

7a. Remove the hex screws (item 3) from the HP-IB connector and the test set interconnect connector. Remove the hex nuts and lock washers from the BNC connectors labeled AUX INPUT, EXT AM, and EXT TRIGGER (item 4). Remove the rear panel assembly.

To Remove the A15 Preregulator

7b. Remove the remaining four screws in the rear frame, two on the top and two on the bottom (item 5).

8. Disconnect the A15 wire bundle (item 6) from A8.
9. Disconnect the A15 wires (item 7) from the motherboard.
10. Pull the preregulator assembly free from the frame.

To Reassemble

11. Reverse the above procedure to reassemble the unit.

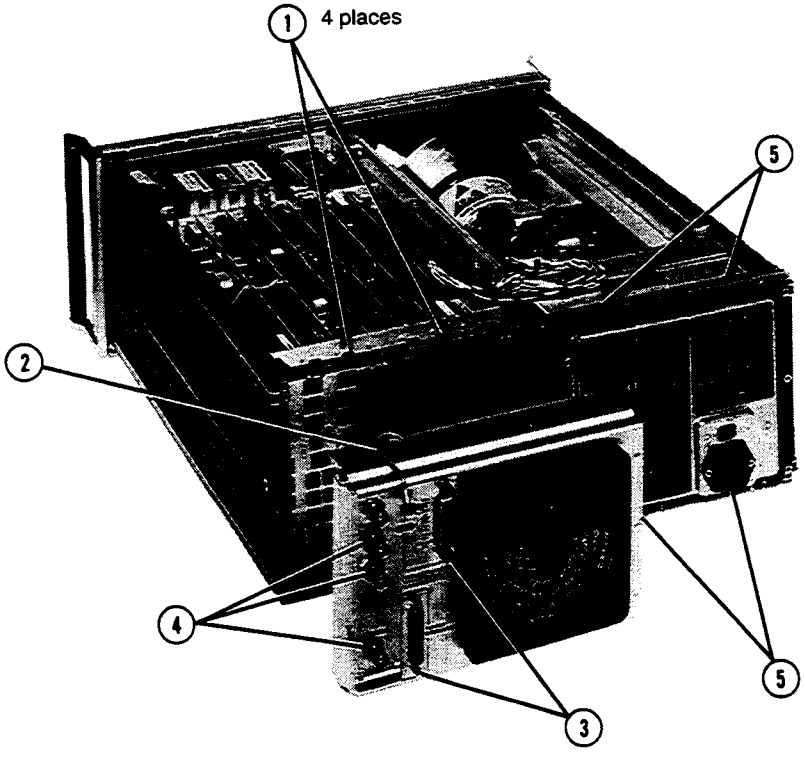


Figure 3. Rear Panel/Preregulator Replacement (1 of 2)

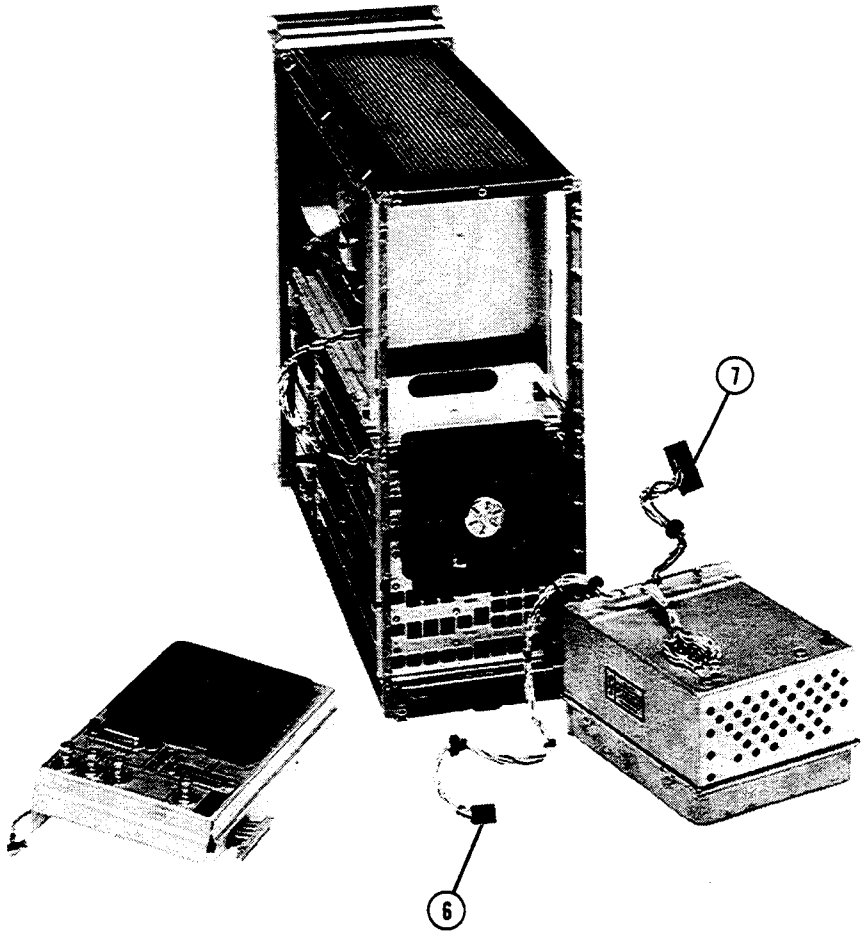


Figure 3. Rear Panel/Preregulator Replacement (2 of 2)

A18 Display Replacement

TOOLS REQUIRED

Medium and large Pozidriv screwdrivers
ESD grounding wrist strap

PROCEDURE

To Disassemble (all instruments)

(Refer to Figure 1.)

1. Remove the power cord and the top and bottom covers.
2. Remove the bezel's softkey cover (item 1) by sliding your fingernail under the left edge, near the top or bottom of the cover. Pry the softkey cover away from the bezel. If you use another tool, take care not to scratch the glass.
3. Remove the two screws and washers (item 2) exposed by the previous step. The bezel (item 3) is now free from the frame. The bezel is heavy for its size. Carefully remove it. Refer to the appropriate section below to continue.

HP 8753C and 8702B

(Refer to Figure 5 for the rest of this procedure.)

4. Remove the gasket from the front of the CRT.
5. Disconnect the ribbon cable (A18W1) from the A19 GSP assembly (item 2).
6. Remove the four screws on the top of the display shield (item 1).
7. Slide the display out of the instrument by pushing on the back of the display assembly. There is a hole at the rear of the display shielding where you can reach in to push the display.

To Reassemble

8. Remove and set aside the bottom shield attached to the replacement display. Install the bottom shield on the old display assembly before it is returned for repair.
9. Leave the ribbon cable (A18W1) in the fastened position for easy retrieval through the rear display shielding.
10. Reverse the first six steps.

(Refer to Figure 4 for the rest of this procedure.)

4. Remove the six screws and washers from the top guide rails of the display (item 1).
5. Turn the instrument over and remove the six screws and washers from the bottom guide rails of the display. Disconnect the four-wire bundle (not shown) from the focus and intensity jacks on the display's X-Y-Z analog board.
6. Turn the instrument right side up. Apply fingertip pressure to the rear of the display's frame. Slide the display approximately two inches out of the instrument frame. Disconnect the power supply cable (item 2).
7. Slide the display approximately three inches out of the mainframe to allow access to the large ribbon cable connector. If necessary, turn the instrument on its side and use two hands to disconnect the ribbon cable from the rear of the display (item 3).
8. Slide the display completely out of the mainframe.
9. To install a new display unit, reverse each step taken to remove the display. When reconnecting the four-wire bundle to the display (HP 8753A/B and 8702A), note that the yellow/black pair goes to the EXT FOCUS jack; and the blue/black pair goes to the J2 EXT jack.

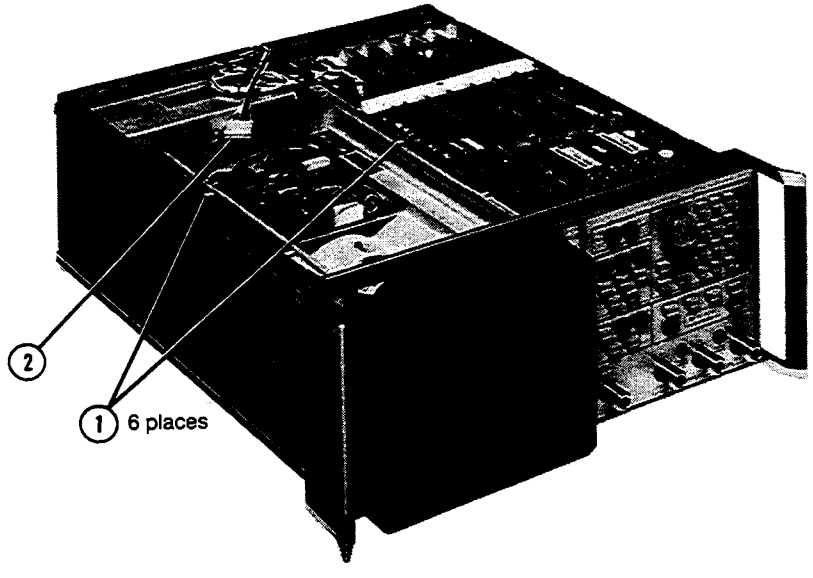


Figure 4. A18 Display Replacement for the HP 8753A/B and 8702A (1 of 2)

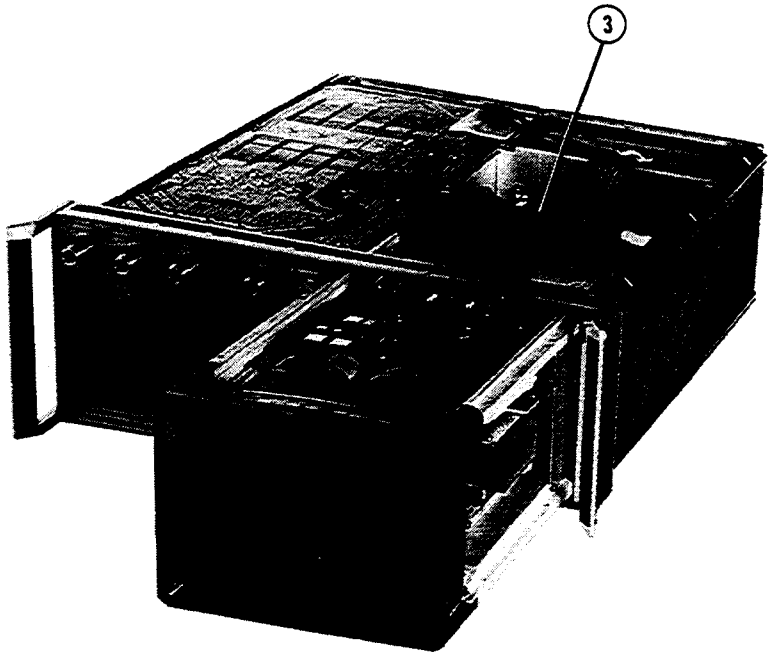


Figure 4. A18 Display Replacement for the HP 8753A/B and 8702A (2 of 2)

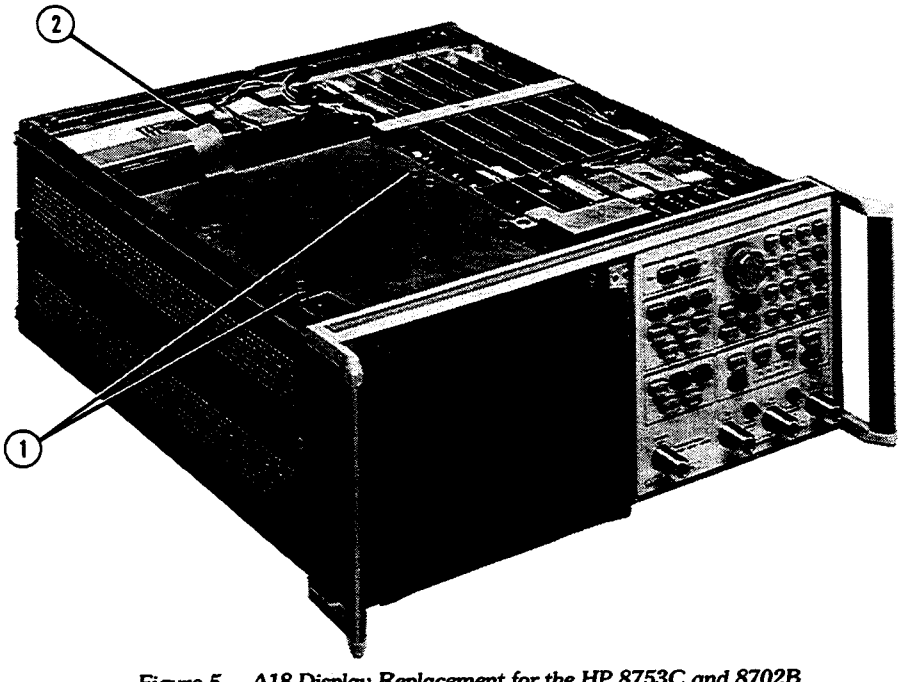


Figure 5. A18 Display Replacement for the HP 8753C and 8702B

INTRODUCTION

The following table, *Related Service Procedures,* lists the additional service procedures which must be performed to ensure that the instrument is working properly following the replacement of an assembly. Note that verification can range from self-test, to various performance tests, to system verification; operation verification is another possibility. These are recommended minimum procedures. If desired, perform operation verification or system verification.

Table 1. Related Service Procedures (1 of 3)

Replaced Assembly	Adjustments/ Correction Constants (CC)	Verification
A1 Front Panel	None	Self-Test
A2 Front Panel Processor	Display Intensity and Focus CC[1]	Self-Test
A3 Source	Analog Bus CC Source Def CC Source Pretune CC Source Spur Avoidance Tracking RF Output Power CC Cavity Oscillator Frequency CC	Output Power Spectral Purity (harmonics and mixer spurs) or On-Site Verification
A4/A5/A6 Sampler/Mixer	Sampler Diode Bias[2] (replaced assembly only) Sampler Magnitude and Phase CC IF Amplifier CC	Minimum R Level (if R sampler replaced) Input Crosstalk Absolute Amplitude Accuracy Frequency Response Input Impedance (replaced assembly only) or On-Site Verification

1. HP 8753A/B and 8702A only.
2. Not applicable to all analyzers. Refer to Adjustments.

Table 1. Related Service Procedures (2 of 3)

Replaced Assembly	Adjustments/ Correction Constants	Verification
A7 Pulse Generator	Sampler Magnitude and Phase CC	Frequency Response Frequency Range and Accuracy Spectral Purity (phase noise) or On-Site Verification
A8 Post-Regulator	Source Spur Avoidance Tracking Cavity Oscillator Frequency CC	Self-Test Check A8 test point voltages
A9 CPU	Display Intensity and Focus CC Serial Number CC Option Number CC Analog Bus CC ADC Linearity CC Source Def CC Source Pretune CC RF Output Power CC Sampler Magnitude and Phase CC IF Amplifier CC Cavity Oscillator Frequency CC Cal Kit Default	Output Power Absolute Amplitude Accuracy Frequency Response Dynamic Accuracy or On-Site Verification
Firmware Rev 1.01 08753-60083	Internal Tests: 46, 45, 48	Self-Test
A10 Digital IF	Analog Bus CC ADC Linearity CC Sampler Magnitude and Phase CC IF Amplifier CC	Receiver Noise Level Trace Noise Input Crosstalk Absolute Amplitude Accuracy Dynamic Accuracy or On-Site Verification
A11 Phase Lock	Analog Bus CC Source Pretune CC	Minimum R Level Frequency Accuracy or On-Site Verification
A12 Reference	High/Low Band Transition Frequency Accuracy	Frequency Range and Accuracy

Table 1. Related Service Procedures (3 of 3)

Replaced Assembly	Adjustments/ Correction Constants	Verification
A13 Fractional-N (Analog)	Fractional-N Spur and FM Sideband	Spectral Purity (other spurious signals) Frequency Range and Accuracy
A14 Fractional-N (Digital)	Fractional-N Frequency Range	Frequency Range and Accuracy or On-Site Verification
A15 Preregulator	None	Self-Test
A16 Rear Panel	None	Execute internal test #13, Rear Panel
A17 Motherboard	None	Self-Test
A18 Display (HP 8753A/B and 8702A)	Display Intensity and Focus CC Display Image Size, Position and Trace Alignment	Observation
A18 Display (HP 8753C and 8702B)	Vertical Position and Focus (only if needed)	Observation
A19 Graphics System Processor	None	Observation

THE PURPOSE OF INSTRUMENT HISTORY

Your manual documents current production versions of the HP 8753 and 8702 instruments. Earlier versions of these products have slight differences in design, which are documented in this section.

With the information provided in this section, this manual can be adapted to apply to any earlier instrument version.

HOW TO USE THIS SECTION

This section documents the HP 8753A, 8753B, 8753C, 8702A, and 8702B separately. For each instrument, where applicable, a table lists the changes opposite the serial number prefix of your instrument.

DETERMINING WHICH INSTRUMENT HISTORY CHANGES APPLY TO THE HP 8753A

Find the prefix number range your instrument falls into, then follow the corresponding directions. Actual changes are provided at the end of this section.

Table 1. Changes for the HP 8753A

Prefix Numbers	Instrument Version	Directions
2816A or Above	Current	Implement Change D
2621A to 2815A	Version 2	Implement Changes A and D
2620A or Below	Version 1	Implement Changes A, B and D

DETERMINING WHICH INSTRUMENT HISTORY CHANGES APPLY TO THE HP 8753B

Find the prefix number range your instrument falls into, then follow the corresponding directions. Actual changes are provided at the end of this section.

Table 2. Changes for the HP 8753B

Prefix Numbers	Instrument Version	Directions
2808A	Current	Implement Change D
2807A or Below	Version 1	Implement Changes A and D

DETERMINING WHICH INSTRUMENT HISTORY CHANGES APPLY TO THE HP 8753C

Find the prefix number range your instrument falls into, then follow the corresponding directions. Actual changes are provided at the end of this section.

Table 3. Changes for the HP 8753C

Prefix Numbers	Instrument Version	Directions
3146A or above	Current	Use the existing manual documentation
3135A	Version 4	Implement Change F
3029A	Version 3	Implement Changes E and F
3025A	Version 2	Implement Change D, E and F
3020A or below	Version 1	Implement Changes C, D, E and F
3140U or above	Current	Use the existing manual documentation
3129U	Version 4	Implement Change F
3033U	Version 3	Implement Changes E and F
3029U to 3032U	Version 2	Implement Changes D, E, and F
2937U or below	Version 1	Implement Changes C, D, E, and F

DETERMINING WHICH INSTRUMENT HISTORY CHANGES APPLY TO THE HP 8702A

Find the prefix number range your instrument falls into, then follow the corresponding directions. Actual changes are provided at the end of this section.

Table 4. Changes for the HP 8702A

Prefix Numbers	Instrument Version	Directions
2750A or above	Current	Use the existing manual documentation
2749A or Below	Version 1	Implement Changes A and D

DETERMINING WHICH INSTRUMENT HISTORY CHANGES APPLY TO THE HP 8702B

Find the prefix number range your instrument falls into, then follow the corresponding directions. Actual changes are provided at the end of this section.

Table 5. Changes for the HP 8702B

Prefix Numbers	Instrument Version	Directions
3026A or above	Current	Use the existing manual documentation
2919A to 3025A	Version 2	Implement Change D
2918A or below	Version 1	Implement Changes C and D

CHANGE A

Instruments requiring Change A were equipped with a different type of fan, fan grille, and A8 post-regulator assembly. In addition, this instrument version was equipped with a fan filter. The newer product version blows air out the back of the instrument and lowers the internal temperature of the instrument. This improves the reliability of the instrument.

Only the new fan and A8 post-regulator assembly are available, and must be replaced as a set. Refer to the information below:

When Replacing the A8 Post-Regulator or B1 Fan

If your instrument has the original fan and A8 assembly, and you must replace a defective A8 assembly: Order the new A8 part number given in the *Replaceable Parts* section, as well as the new fan kit number. The old fan needs to be replaced because it is incompatible with the new A8 assembly. Remember to order the part number of the fan replacement kit, not the part number of the fan itself.

If your instrument has the original fan and A8 assembly, and you must replace a defective fan: Order the replacement fan kit part number. This kit contains the parts required to modify the existing A8 post-regulator assembly, as well as instructions. Because of this, you do not need to order a new A8 assembly when installing a new fan.

How to Tell if Your Instrument Has the Original Fan and A8 Assembly

The original fan pulls air into the instrument through a filter. If your instrument has a fan filter, and pulls air into the instrument through it \n you have the original fan type.

If your A8 assembly is HP part number 08753-60108 or 08753-69108, it is the original version.

How to Tell if Your Instrument Has Already Been Upgraded with a New Fan and A8 Assembly

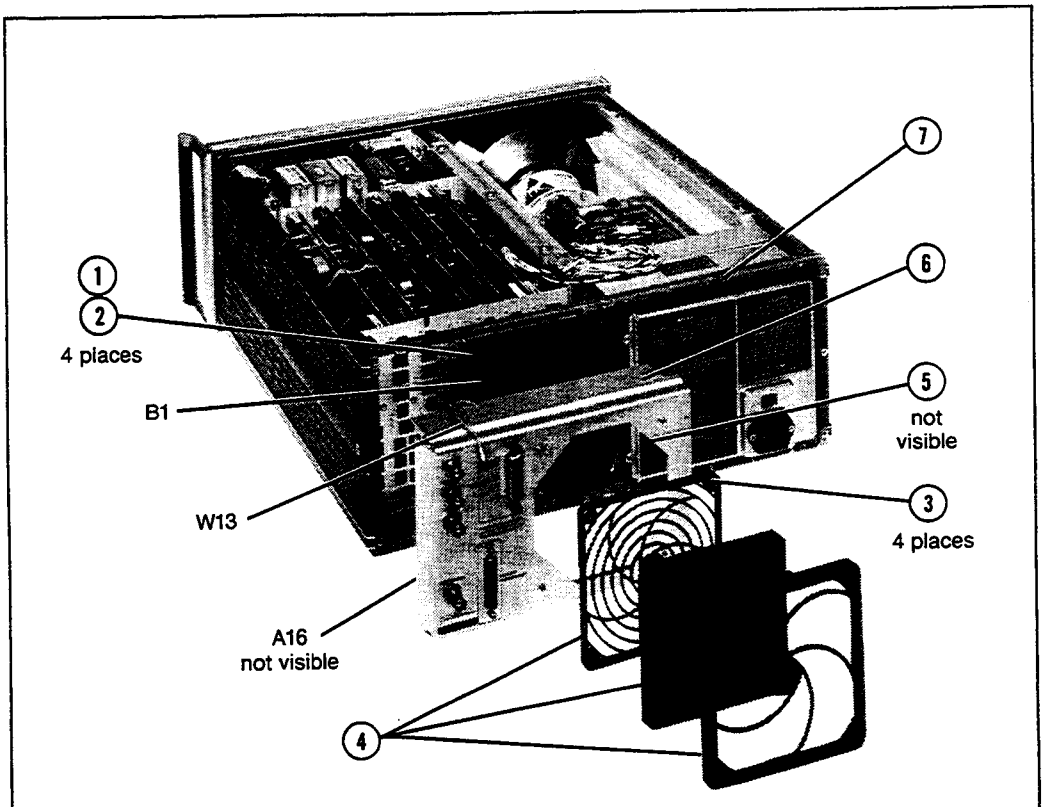
Your instrument has been properly upgraded if all the following conditions exist:

- The instrument does not have a fan filter.
- The A8 assembly is HP part number 08753-60093 or 08753-69093.
- The fan blows out the back of the instrument (unless the fan has been turned around to be compatible with certain types of racked systems).

WHEN TO USE CHANGE A

Change A is comprised of the attached Figure 14, Rear Panel Assemblies, which belongs in the *Replaceable Parts* section.

Use Figure 14 if you only need to replace the original fan filter, filter guard, plastic grille, or mounting screws.



Ref. Desig.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-0965	9	4	SCREW-SKT-HD-CAP M3 X 0.5 14MM-LG	28480	0515-0965
2	2190-0584	0	4	WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
3*	0515-1054	9	4	SCREW-MACH M3 X 0.5 9MM-LG 90-DEG-FLH-HD	28480	0515-1054
4	3150-0484	6	1	FILTER, FILTER GUARD & RETAINER, 4.65	28480	3150-0484
5	08753-20040	2	1	FAN GASKET	28480	08753-20040
6	08753-00019	3	1	REAR PANEL	28480	08753-00019
7				REAR FRAME – SEE FIGURE 6		
A16	08753-60016	6	1	REAR PANEL BOARD ASSY (INCLUDES A16W1)	28480	08753-60016
B1	08753-60047	3	1	FAN (INCLUDES CONNECTING CABLE ASSY)	28480	08753-60047
W13				FLEXIBLE RF CABLE ASSEMBLY – A12 TO REAR PANEL SEE FIGURE 4		
*CAUTION: This hardware is metric. Use of other thread types is likely to damage threaded holes.						

Figure 14. Rear Panel, Assemblies

CHANGE B

Change B only applies to HP 8753As with serial prefix numbers of 2620A and below.

Make the following changes to the *Replaceable Parts* section:

Page 9:
Change MP3 to HP part number 08753-40004, CD 0, PC Board Stabilizer.
Delete item 11, item 6, and MP4.

Page 18
Delete item 6.

CHANGE C

The part number for the A19 GSP assembly is 08753-60092.

The part number for the rebuilt-exchange A19 GSP assembly is 08753-69092.

CHANGE D

The replacement part number of the HP 8753C A11 phase lock assembly is 08753-60207. When used with HP 8753C firmware revision 4.02 or higher, or HP 8753B firmware revision 3.0 or higher, the A11 assembly adds a new measurement capability. The added capability allows measuring LO frequencies higher than the RF output of the analyzer in frequency offset mode. Earlier HP 8753B/C instruments could measure RF > LO only. This measurement capability cannot be added to HP 8753A or HP 8702A/B instruments.

Part number 08753-60207 is not compatible with earlier versions of the HP 8753A or B or C or any version of the HP 8702A or B. See Figure 2 (2 of 3) in the "Replaceable Parts" section for the recommended replacement for these instruments.

CHANGE E

The replacement part number of the A16 rear panel board assembly is 08752-60013. This assembly has an input/output external trigger circuit. This circuit enables the HP 8753C to work with an HP 8625A synthesized RF source in making measurements of frequency translation devices. The rear panel board also includes modifications to improve the interface between the TTL logic of the rear panel and the HCL logic of the accessory test sets. (This board can be used in older HP 8753Cs and 8702Bs.)

CHANGE F

The replacement part number of the A9 CPU assembly is 08753-60138. This assembly includes firmware revision 4.11 which adds extended mixer measurement capabilities. The added capability allows swept-LO, fixed-IF mixer measurements. The RF output is calculated in a similar manner as with fixed LO measurements, only now the analyzer's output tracks the LO frequency rather than the fractional-N. This new measurement capability cannot be added to HP 8753A/B or HP 8702A/B instruments.

INDEX

Entries in this index are identified by a two or three word acronym and number. Each acronym, as explained in the KEY on the bottom of each page, stands for one of twenty-two sections. Each section has its own tab.

Example:"+0.37V, Analog Bus Node 9 SKM 19" means that analog bus node 9 (+0.37V) is described in the *Service Key Menus* section on page 19.

Use this index to learn more about:

- Softkeys: keys next to the CRT, printed ***[SOFTKEY]*** in text.
- Hardkeys: dedicated front panel keys, printed **[HARDKEY]** in text.
- CRT messages: visible during normal operation and service routines.
- Error messages: indexed without the initial "CAUTION".
- Analog bus nodes: listed by name and number.
- Adjustments: listed by title and function.

ASSEMBLIES

The assemblies below are indexed as follows:

A1	see Front Panel	A11	see Phase Lock
A2	see Front Panel	A12	see Reference (Frequency)
A3	see Source	A13	see Fractional-N
A4	see Sampler	A14	see Fractional-N
A5	see Sampler	A15	see Preregulator
A6	see Sampler	A16	see Rear Panel
A7	see Pulse Generator	A17	see Motherboard
A8	see Post-Regulator	A18	see CRT and Display
A9	see CPU	A19	see GSP
A10	see Digital IF		

KEY:

ACC	Accessories	PRP	Post-Repair Procedures
ADJ	Adjustments	PS	Power Supply
DC	Digital Control	PT	Performance Tests
ET	Error Terms	RCV	Receiver
IFG	Isolate Faulty Group	RP	Replaceable Parts
INH	Instrument History	SEO	Service and Equipment Overview
OSV	On-Site Verification	SKM	Service Key Menus
PM	Preventive Maintenance	SRC	Source
PRO	Replacement Procedures	TO	Theory of Operation
		TS	Troubleshooting and Block Diagram

+0.37V, Analog Bus Node 9 ..... SKM 20
+2.50V, Analog Bus Node 10 ..... SKM 20
100 kHz ..... ADJ 29
100 kHz, Analog Bus Node 21 ..... SKM 25
1V/GHz, Analog Bus Node 16 ..... SKM 22
2nd LO, Analog Bus Node 24 ..... SKM 26
6 GHz Theory of Operation (HP 8753B/C, HP 8702) ..... TO 20
75 Ohm Connectors ..... ACC 2
A10 Gnd, Analog Bus Node 12 .... SKM 21
A12 Gnd 1, Analog Bus Node 22 .. SKM 25
A12 Gnd, Analog Bus Node 28 .... SKM 27
A3 Gnd, Analog Bus Node 8 ..... SKM 20
A9CC Jumper Position ..... ADJ Tab, ADJ 3
Abbreviations ..... RP 3
Abort Softkey ..... SKM 3
Absolute Amplitude Accuracy Performance Test ..... PT 18
ABUS Check ..... IFG 6
ABUS Cor (Adjustment Test) ..... SKM 8
ABUS Node 16 ..... IFG 6
ABUS Test (Internal Test) ..... SKM 6
Accuracy Enhancement ..... OSV 4, ET 1
ADC Hist (External Test) ..... SKM 7
ADC Lin (Internal Test) ..... SKM 6
ADC Linearity Correction Constants .. ADJ 17
ADC Ofs (Internal Test) ..... SKM 6
ADC Ofs Cor (Adjustment Test) ..... SKM 8
Add Softkey ..... SKM 4
Adjustment Procedures ..... ADJ 3-54
Adjustment Tests ..... SKM 8
Adjustments, Order of ..... ADJ 2
Adjustments, Following: see Post-Repair Procedures
All Int (Internal Test) ..... SKM 5
Amp In, Analog Bus Node 3 ..... SKM 17
Analog Bus Correction Constants ... ADJ 16
Analog Bus, Description ..... SKM 14
Analog Bus Codes ..... SKM 31
Analog Bus Nodes 1-31 ..... SKM 16-29
Analog Bus Softkey ..... SKM 14, 15
Analog In Menu ..... SKM 15
Analyzer Functional Groups ..... TO 5
API1-4 ..... ADJ 29
Application Problems: see Possible Operation Problems
Assemblies, How to Replace ..... PRO 1
Assembly Removal ..... PRO 1
Attenuation Control Check ..... ACC 8
Automated Performance Tests ..... PT 25
Aux Input, Analog Bus Node 11 .... SKM 21
Aux Out Softkey ..... SKM 15
Band Step ..... ADJ 33
Block Diagram: see Overall Block Diagram
Cable Replacement (of Analyzer) .... RP 11, 12, 19, 20, 24-26
Cable Replacement (RF Cable Manual part numbers) ..... RP 28
Cable Test ..... ACC 5
Cal Coef 1-12 (System Verification Test) SKM 7
Cal Factor Sensor A (or B) Softkey ... SKM 4
Cal Kit Def (Adjustment Test) ..... SKM 8
Calibration Coefficient Terms ..... ET 3
Calibration Cycle ..... PT 4
CAV ADJ ..... ADJ 30
Cav Osc Cor (Adjustment Test) ..... SKM 8
Cavity Oscillator Correction Constants ADJ 47
Cleaning the Fan Filter ..... PM 2
Cleaning the Glass Filter ..... PM 1
Clear List Softkey ..... SKM 4
CMOS RAM (Internal Test) ..... SKM 5
Connectors, 75 Ohm ..... ACC 2

KEY:

ACC	Accessories
ADJ	Adjustments
DC	Digital Control
ET	Error Terms
IFG	Isolate Faulty Group
INH	Instrument History
OSV	On-Site Verification
PM	Preventive Maintenance
PRO	Replacement Procedures
PRP	Post-Repair Procedures
PS	Power Supply
PT	Performance Tests
RCV	Receiver
RP	Replaceable Parts
SEO	Service and Equipment Overview
SKM	Service Key Menus
SRC	Source
TO	Theory of Operation
TS	Troubleshooting and Block Diagram

Connectors, Loose on Test Set ..... ACC 2
Cont Softkey ..... SKM 13
Continue Softkey ..... SKM 3
Controller Problems, Troubleshooting ... TS 8
Conversion Kits ..... RP 28
Correction Constants ..... ADJ 1
Count Gate, Analog Bus Node 31 .. SKM 29
Counter: Off Softkey ..... SKM 15
Cover Removal ..... ADJ Tab
CPU LED Pattern ..... DC 4, DC 18
CPU Theory of Operation ..... TO 10
CRT Abbreviations ..... SKM 3
CRT Trace Check ..... RCV 8
CRT: see also Display
Degaussing, Display ..... ADJ 9
Delete Softkey ..... SKM 4
Designations ..... RP 3
Det, Analog Bus Node 4 ..... SKM 18
DIF Control (Internal Test) ..... SKM 6
DIF Counter (Internal Test) ..... SKM 6
Diagnostics:see Self Diagnose Feature see Self Tests
Digital Control Block Diagram ..... DC 2
Digital Control Signals Check ..... SRC 22
Digital Control Troubleshooting Summary DC 3
Digital Control Theory of Operation ..... TO 8
Digital IF Check ..... RCV 5
Digital IF Theory of Operation ..... TO 22
Directivity Error Term ..... ET 5
Disp 2 Ex (Adjustment Test) ..... SKM 8
Disp/cpu com (Display Test) ..... SKM 9
Display (Error) Messages ..... PS 15
Display Check ..... DC 4, DC 19
Display Degaussing ..... ADJ 9
Display Image Size, Position and Trace Alignment ..... ADJ 5
Display Intensity and Focus ..... ADJ 4
Display Intensity Adjustments ..... ADJ 10
Display Power Cable, Location of ..... PS 11
Display Replacement ..... PRO 10
Display Test Pattern ..... DC 12
Display Tests Softkey ..... SKM 3
Display Test, Internal ..... DC 24
Display Troubleshooting ..... DC 11, DC 23
Display Theory of Operation ..... TO 11
Div Frac N Softkey ..... SKM 15
Divide-by-N Circuit Check ..... SRC 21
Documentation ..... RP 28
Done Softkey ..... SKM 4
DRAM cell (Display Test) ..... SKM 9
Dropout: see Power Hole Test
DSP ALU (Internal Test) ..... SKM 6
DSP Control (Internal Test) ..... SKM 6
DSP Intrpt (Internal Test) ..... SKM 6
DSP RAM (Internal Test) ..... SKM 5
DSP Wr/rd (Internal Test) ..... SKM 5
E-Terms: see Error Terms ..... ET 1
Edit List Menu ..... SKM 4
Edit Softkey ..... SKM 4
EEPROM Backup Disk Procedure ... ADJ 53
Environment, Operating: see *Operating Manual*
Environment: see also Power Supply Hot
Equipment, for System Verification .... OSV 4
Error Codes: see Error Messages
Error Messages (Accessories Related) .. IFG 8
Error Messages (Adjustment Related) . ADJ 1
Error Messages (Phase Lock Loop Related) ..... SRC 29
Error Messages (Power Supply Related) PS 15

KEY:

ACC	Accessories
ADJ	Adjustments
DC	Digital Control
ET	Error Terms
IFG	Isolate Faulty Group
INH	Instrument History
OSV	On-Site Verification
PM	Preventive Maintenance
PRO	Replacement Procedures
PRP	Post-Repair Procedures
PS	Power Supply
PT	Performance Tests
RCV	Receiver
RP	Replaceable Parts
SEO	Service and Equipment Overview
SKM	Service Key Menus
SRC	Source
TO	Theory of Operation
TS	Troubleshooting and Block Diagram

Error Messages (Receiver Related) IFG 8, RCV 3
Error Messages (Source Related) IFG 4, SRC 29
Error Term Check ..... PM 3
Error Term Descriptions ..... ET 4
Error Term Inspection ..... ET 3
Error Term Troubleshooting ..... ACC 3
Error Terms ..... ET 1
Exchange Assemblies ..... RP 1
Execute Test Softkey ..... SKM 3
Ext Ref, Analog Bus Node 26 ..... SKM 27
External Source Mode Theory of Operation (HP 8753B/C, HP 8702) ..... TO 18
External Tests ..... DC 11, SKM 7
Fan Filter ..... PM 2
Fan Not On ..... PS 17
Fan Troubleshooting ..... PS 17
Filter, CRT: see Glass Filter
Filter, Fan: see Fan Filter
Firmware Problems ..... DC 4
Firmware Revision Softkey ..... SKM 30
First LO Check ..... RCV 9
FN Count (Internal Test) ..... SKM 6
FN VCO ADJ ..... ADJ 19
FN VCO Det, Analog Bus Node 30 . SKM 28
FN VCO Tun, Analog Bus Node 29 . SKM 27
Foc/Int Cor (Adjustment Test) ..... SKM 8
Fr Pan Diag (External Test) ..... SKM 7
Fr Pan Seq (External Test) ..... SKM 7
Fr Pan Wr/Rd (Internal Test) ..... SKM 6
Frac N Cont (Internal Test) ..... SKM 6
Frac N Softkey ..... SKM 15
Fracn Tune Softkey ..... SKM 12
Fractional-N Check ..... SRC 18
Fractional-N Frequency Range Adjustment ..... ADJ 18
Fractional-N Spur and FM Sideband Adjustment ..... ADJ 27
Fractional-N Theory of Operation .... TO 12
Frequency (System Test) ..... OSV 15
Frequency Accuracy Adjustment .... ADJ 23
Focus Display ..... ADJ 4,7
Frequency Check ..... SRC 10
Frequency Counter (Internal) ..... SKM 14
Frequency Offset Mode Performance Test,Supplemental PT84
Frequency Offset Theory of Operation (HP 8753B/C) ..... TO 17
Frequency Performance Test ..... PT 5
Frequency Response Performance Test PT 16
Front Panel Connector Check ..... PM 3
Front Panel Connector Gaging ..... PM 3
Front Panel Error Codes Test ..... DC 6
Front Panel LED Check ..... DC 6
Front Panel Processor Theory of Operation TO 8
Front Panel Replacement ..... PRO 1
Front Panel Troubleshooting ..... DC 19
Front Panel Theory of Operation ..... TO 9
Fuse, Line ..... PS 6
Glass Filter ..... PM 1
GSP Display Voltages ..... DC 23
GSP Theory of Operation ..... TO 11
GSP Troubleshooting ..... DC 23
GSP Walking One Pattern ..... DC 25
HP 8753A Component Compatibility SRC 5, 30
Hard Failures ..... ACC 1
Hardkeys ..... SKM 2
Harmonic Analysis Theory of Operation TO 17
Harmonics Option 002 (System Test) OSV 24
HBLB ADJ ..... ADJ 26
High Band Theory of Operation ..... TO 13

KEY:

ACC	Accessories
ADJ	Adjustments
DC	Digital Control
ET	Error Terms
IFG	Isolate Faulty Group
INH	Instrument History
OSV	On-Site Verification
PM	Preventive Maintenance
PRO	Replacement Procedures
PRP	Post-Repair Procedures
PS	Power Supply
PT	Performance Tests
RCV	Receiver
RP	Replaceable Parts
SEO	Service and Equipment Overview
SKM	Service Key Menus
SRC	Source
TO	Theory of Operation
TS	Troubleshooting and Block Diagram

High/Low Band Transition Adjustment ADJ 25
HP-IB Problems ..... DC 27
HP-IB Service Mnemonic Definitions SKM 30
HP-IB Troubleshooting ..... TS 7
IF Amplifier Correction Constants .... ADJ 45
IF Det 1, Analog Bus Node 20 ..... SKM 25
IF Det 2N, Analog Bus Node 18 .... SKM 24
IF Det 2W, Analog Bus Node 19 .... SKM 25
IF Gain Auto Softkey ..... SKM 13
IF Gain Off Softkey ..... SKM 13
IF Gain On Softkey ..... SKM 13
IF Step Cor (Adjustment Test) ..... SKM 8
IF, Analog Bus Node 17 ..... SKM 23
Input Crosstalk Performance Test ..... PT 11
Input Impedance Performance Test ... PT 21
Input Problems ..... RCV 4
Instrument Disassembly: see Replacement Procedures
Integ, Analog Bus Node 6 ..... SKM 19
Intensity, Display Adjustments .... ADJ 4, 10
Inten DAC (Display Test) ..... SKM 9
Intermittent Problems ..... PS 17, DC 15
Internal Diagnostics Menus ..... SKM 2
Internal Tests ..... IFG 3, SKM 5
Isolation Crosstalk Error Term ..... ET 8
Keyword label ..... ADJ 14
Kits to Upgrade Instruments ..... RP 28
Labels (Used on Instrument) ..... RP 27
Lightwave System Problems ..... ACC 10
Lightwave System Test ..... OSV 31
Lightwave System Troubleshooting ..... TS 4
Lightwave System Verification: see On-Site Verification
Limits Softkey ..... SKM 4
Line Fuse ..... PS 6
Line Voltage Selector ..... PS 6
LM In, Analog Bus Node 1 ..... SKM 16
LM Out, Analog Bus Node 2 ..... SKM 17
Load Match Error Term ..... ET 9
Log, Analog Bus Node 7 ..... SKM 19
Loose Test Set Connectors ..... ACC 2
Low Band Theory of Operation ..... TO 15
Main ADC ..... SKM 14
Main DRAM (Internal Test) ..... SKM 5
Main VRAM (Display Test) ..... SKM 9
Manual Backdating: see Instrument History
Manual Organization ..... SEO 1
Manuals (of the System) ..... RP 28
Measurement Calibration Coefficients ... ET 1
Measurement Calibration Procedure .... ET 2
Measurement Discrepencies ..... ACC 1
Measurement Uncertainty ..... OSV 3
Minimum R Level Performance Test .... PT 7
Mixer Theory of Operation ..... TO 13, 21
Mnemonic Definitions of HP-IB ..... SKM 30
Module Exchange Procedure ..... RP 5
Motherboard, Inspect ..... PS 12
More Softkey ..... SKM 13
Next Softkey ..... SKM 3
No Front Panel Control of Instrument .. DC 6
No IF Found: Check R Input Level IFG 4, SRC 29
No Phase Lock: Check R Input Level . IFG 4, SRC 29
Noise Floor ..... IFG 8
Noise Level, Receiver (System Test) . OSV 20
On-Site Verification ..... OSV 1
On-Site Verification Equipment .. SEO Table 1
Open, How to Verify a ..... ACC 5

KEY:

ACC	Accessories
ADJ	Adjustments
DC	Digital Control
ET	Error Terms
IFG	Isolate Faulty Group
INH	Instrument History
OSV	On-Site Verification
PM	Preventive Maintenance
PRO	Replacement Procedures
PRP	Post-Repair Procedures
PS	Power Supply
PT	Performance Tests
RCV	Receiver
RP	Replaceable Parts
SEO	Service and Equipment Overview
SKM	Service Key Menus
SRC	Source
TO	Theory of Operation
TS	Troubleshooting and Block Diagram

Opens, "Bad" ..... ACC 2
Operation Problems ..... ACC 1
Operation Verification Tests ..... PT 3
Operator's Check ..... TS 2, SKM 7
Option Cor (Adjustment Test) ..... SKM 8
Option Number Correction Constants ADJ 14
Order of Adjustments ..... ADJ 2
Ordering Information ..... RP 2
Overall Block Diagram ..... at the end of TS
Overload On Input A/B/R; Power Reduced ..... IFG 8, RCV 3
Part Ordering Information ..... RP 2
Pause Softkey ..... SKM 13
Peek Softkey ..... SKM 29
Peek/Poke Address Softkey ..... SKM 29
Peek/Poke Menu ..... SKM 29
Peek/Poke Softkey ..... SKM 29
Performance Test Equipment ... SEO Table 1
Performance Test Frequency ..... PT 4
Performance Test Record ..... PT 89
Performance Tests vs On-Site Verification PT 2
Phase Lock Cal Failed ..... IFG 4, SRC 29
Phase Lock Check ..... SRC 6, 27
Phase Lock Diagnostic Routines ..... SRC 30
Phase Lock Error Messages . IFG 4, SRC 29
Phase Lock Loop Troubleshooting .... SRC 4
Phase Lock Lost ..... IFG 4, SRC 29
Phase Lock Theory of Operation ..... TO 12
PLL Auto Softkey ..... SKM 12
PLL Diag Softkey ..... SKM 12
PLL Pause Softkey ..... SKM 13
PL Ref, Analog Bus Node 25 ..... SKM 26
Poke Softkey ..... SKM 29
Possible False Lock ..... IFG 4
Possible Operation Problems ..... ACC 1
Post Reg (Internal Test) ..... SKM 6
Post-Regulator LEDs ..... IFG 2
Post-Regulator Voltages ..... PS 5
Post-Regulator Theory of Operation ... TO 7
Pow Met Invalid (Error Message) ..... ADJ 1
Pow Met Not Found (Error Message) . ADJ 1
Pow Met Not Settled (Error Message) . ADJ 1
Power (System Test) ..... OSV 17
Power Hole Test (System Test) ..... OSV 19
Power Level Accuracy (System Test) . OSV 18
Power Level Flatness (System Test) .. OSV 18
Power Level Troubleshooting ..... SRC 3
Power Loss Softkey ..... SKM 4
Power Probe Shut Down! ..... IFG 8
Power Sensor Softkey ..... SKM 4
Power Supply Block Diagram ..... PS 2
Power Supply Hot ..... PS 15
Power Supply Shut Down! ..... PS 15
Power Supply Theory of Operation .... TO 5
Power Up Sequence ..... IFG 2
Preregulator (A15) Check ..... PS 8
Preregulator Replacement ..... PRO 7
Preregulator Theory of Operation ..... TO 6
Preset (Internal Test) ..... SKM 5
Pretune Cor (Adjustment Test) ..... SKM 8
Pretune Def (Adjustment Test) ..... SKM 8
Pretune, Analog Bus Node 15 ..... SKM 22
Preventive Maintenance, Tasks ..... PM 1
Preventive Maintenance, How Often ... PM 1
Preventive Maintenance Use of Error Terms ET 1
Probe Power Shut Down! ..... PS 15
Probe Power Voltages ..... PS 15
Pulse Generator Check ..... SRC 23, 25
Pulse Generator Theory of Operation . TO 12

KEY:

ACC	Accessories
ADJ	Adjustments
DC	Digital Control
ET	Error Terms
IFG	Isolate Faulty Group
INH	Instrument History
OSV	On-Site Verification
PM	Preventive Maintenance
PRO	Replacement Procedures
PRP	Post-Repair Procedures
PS	Power Supply
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RCV	Receiver
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SEO	Service and Equipment Overview
SKM	Service Key Menus
SRC	Source
TO	Theory of Operation
TS	Troubleshooting and Block Diagram

R&A Op Check (External Test) ..... SKM 7
R&B Op Check (External Test) ..... SKM 7
Random Errors ..... OSV 4
Rear Panel (Internal Test) ..... SKM 6
Rear Panel LED ..... IFG 2
Rear Panel Replacement ..... PRO 7
Rear Panel Theory of Operation ..... TO 11
Rebuilt-Exchange Assemblies ..... RP 1
Receiver Noise Level (System Test) . OSV 20
Receiver Noise Level Option 006 (System Test) ..... OSV 22
Receiver Noise Level Option 006 (System Test) ..... OSV 22
Receiver Noise Level Performance Test . PT 9
Receiver Troubleshooting Summary .. RCV 2
Receiver Theory of Operation ..... TO 21
Record Softkey ..... SKM 4
Reference Check ..... SRC 10
Reference Designations ..... RP 3
Reference Theory of Operation ..... TO 12
Reflection Tracking Error Term ..... ET 7
Related Service Procedures ..... PRP 1
Remote Trigger (for Test Set) Check ACC 10
Removal of Assemblies ..... PRO 1
Repair Sequence ..... TS 1
Repair, How To Check ..... PRP 1
Repair, What To Do After ..... PRP 1
Repeat Softkey ..... SKM 4
Repeat Test Function ..... DC 15, 26
Replacement Procedures ..... PRO 1
Replacement, How To Check ..... PRP 1
Replacement, What To Do Next ..... PRP 1
Required Test Equipment ..... SEO 3
Reset Memory Softkey ..... SKM 29
Resolution Softkey ..... SKM 15
RF Output Power Correction Constants ADJ 41
RGB Connectors ..... TO 11
RGB Outputs (Display Test) ..... SKM 9
Rolloff ..... ADJ 33
ROM (Internal Test) ..... SKM 5
ROM/RAM Tests ..... SKM 32
Sampler Check ..... SRC 5
Sampler Cor (Adjustment Test) ..... SKM 8
Sampler Cor Softkey ..... SKM 13
Sampler Diode Bias Adjustment ..... ADJ 32
Sampler Magnitude and Phase ..... ADJ 35
Sampler Theory of Operation ..... TO 13, 21
Schematic: see Overall Block Diagram
SDIS: see Shutdown Circuitry
Second LO Check ..... RCV 9
Segment Softkey ..... SKM 4
Select Softkey ..... SKM 3
Self Diagnose Feature ..... DC 9
Self Diagnose Softkey ..... SKM 5
Self Tests ..... DC 9
Serial Cor (Adjustment Test) ..... SKM 8
Serial Number Correction Constant .. ADJ 13
Service Feature Menus ..... SKM 11
Service Modes Menu ..... SKM 12
Service Modes More Menu ..... SKM 13
Service Notes ..... RP 29
Service Overview ..... SEO 1
Service Tools ..... RP 28
Short, How to Verify a ..... ACC 5
Shorts, "Bad" ..... ACC 2
Shutdown Circuitry ..... PS 14
Soft Failures ..... ACC 1
Softkeys ..... SKM 2
Software ..... RP 28
Source Check ..... IFG 5, SRC 6

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Source Cor (Adjustment Test) ..... SKM 8
Source Def (Adjustment Test) ..... SKM 8
Source Ex (External Test) ..... SKM 7
Source Match Error Term ..... ET 6
Source PLL Softkey ..... SKM 12
Source Power (System Test) ..... OSV 17
Source Default Correction Constants . ADJ 21
Source Pretune Correction Constants ADJ 22
Source Replacement ..... PRO 5
Source Spur Avoidance Tracking Adjustment ..... ADJ 30
Source Troubleshooting Summary .... SRC 2
Source Theory of Operation ..... TO 12
Spur Avoid Softkey ..... SKM 13
Spur Test Softkey ..... SKM 13
SRC Tune Softkey ..... SKM 12
Store EEPR Softkey ..... SKM 13
Stuck Key ..... DC 8, 19
Supplemental Performance Test Record PT 92
Sweep Delay Check ..... ACC 10
Sweep Time Too Fast ..... IFG 4
Sweep Trig (Internal Test) ..... SKM 6
Switch Repeatablilty ..... ACC 3
Symbol Conventions (of HP-IB Mnemonics) ..... SKM 31
Sys Ver Init (System Verification Test) SKM 7
Sys Ver Tests ..... SKM 7
System Test Record ..... OSV 27
System Tests ..... OSV 15
System Tests: see On-Site Verification
System Theory of Operation ..... TO 1
System Verification ..... OSV 3
System Verification Cycle ..... OSV 3
System Verification Equipment ..... OSV 4
System Verification Tests ..... SKM 7
System Verification Troubleshooting .. OSV 12
Systematic Error Sources ..... ET 1
Systematic Errors ..... OSV 4
Table of Service Test Equipment ..... SEO 3
Temp, Analog Bus Node 5 ..... SKM 19
Temperature, Maximum Operating .... PS 12
Test Descriptions ..... SKM 5
Test Equipment, Required ..... SEO 3
Test Options Menu ..... SKM 4
Test Options Softkey ..... SKM 4
Test Patterns ..... SKM 9
Test Record, Performance ..... PT 89
Test Record, System ..... OSV 27
Test Set Connectors, Loose ..... ACC 2
Test Set Doubler Check (HP 85047A) . ACC 8
Test Set Problems (Power or Control) . ACC 6
Test Set Switch Check ..... ACC 3
Test Set Theory of Operation ..... TO 3
Test Set Transfer Switch Check ..... ACC 8
Test Status Terms ..... SKM 3
Tests Menu ..... SKM 3
Tests Softkey ..... SKM 3
Tests, How to Invoke by HP-IB ..... SKM 31
Theory of Operation ..... TO 1
Trace Align, Display ..... ADJ 5, 6
Trace Noise Performance Test ..... PT 14
Transmission Tracking Error Term ..... ET 10
Trouble! Check Set-up And Start Over(Error Message) ..... ADJ 1
Troubleshooting Lightwave Systems .... TS 4
Troubleshooting Lightwave System Problems ..... ACC 10
Troubleshooting Measurement Problems . TS 2

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Troubleshooting Reference: see Service Key Menus
Troubleshooting Strategy ..... TS 1
Troubleshooting With Error Terms ACC 3, ET 1
Troubleshooting, How to Begin ..... TS 2
Tuned Receiver Mode Theory of Operation(HP 8753B/C, HP 8702) ..... TO 19
Turn On Sequence ..... IFG 2
Upgrade Kits ..... RP 28
User Misunderstandings:see Possible Operation Problems
Vbb Ref, Analog Bus Node 14 ..... SKM 21
VCO Range Check ..... SRC 19
VCO TUNE ..... ADJ 26
VCO Tune 2, Analog Bus Node 13 .. SKM 21
VCO Tune, Analog Bus Node 23 ... SKM 25
VCXO ADJ ..... ADJ 24
VCXO Tune, Analog Bus Node 27 .. SKM 27
Ver Dev 1-4 (System Verification Test) SKM 7
Verification ..... PT i, OSV i
Verification Considerations ..... PT 1
Verification Devices, Use of ..... OSV 9
Verification Kit Re-Certification ..... OSV 3
Vertical Position and Focus Adjustments ADJ 2
Voltage Selector ..... PS 6
VRAM Bank (Display Test) ..... SKM 9
VRAM/Video (Display Test) ..... SKM 9
What To Do After a Repair ..... PRP 1
Wiring List ..... at the end of TS
X-Gain, Display ..... ADJ 5
X-Pos, Display ..... ADJ 5
Yes Softkey ..... SKM 3
Y-Gain, Display ..... ADJ 5
YO Coil Drive Check ..... SRC 8, 9
Y-Pos, Display ..... ADJ 5

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